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A STUDY OF THE SOCIAL AND ECONOMIC IMPACT OF ODORS

PHASE III. DEVELOPMENT AND EVALUATION OF A MODEL ODOR CONTROL ORDINANCE

COPLEY INTERNATIONAL CORP.

PREPARED FOR
ENVIRONMENTAL PROTECTION AGENCY

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SOCIAL AND ECONOMIC IMPACT OF ODORS

Phase III

Final Report Prepared for the
ENVIRONMENTAL PROTECTION AGENCY

February 1973

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SOCIAL AND ECONOMIC IMPACT OF ODORS
Phase III

DEVELOPMENT AND EVALUATION OF A MODEL ODOR CONTROL ORDINANCE

Prepared for the

ENVIRONMENTAL PROTECTION AGENCY
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By

COPLEY INTERNATIONAL CORPORATION
7817 Herschel Avenue
La Jolla, California 92037

Contributions to this report were made by

POPE, EVANS AND ROBBINS, INC.
564 Market Street
San Francisco, California 94104

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16. Abstracts

The aim was the preparation of a model odor control ordinance that could be adopted and applied effectively by enforcement authorities throughout the United States. To meet this objective the following tasks were undertaken: (1) preparation of a tentative form of a model ordinance; (2) selection of four air pollution control agencies to evaluate the procedures developed in the second phase of research along with the model ordinance; (3) instruction of employees of the selected agencies in the proper use of the procedures in relation to the model ordinance; (4) guidance of selected agencies' project related field activities; and (5) refinement of the procedures and the model ordinance for submission to the Environmental Protection Agency. It is concluded that a model ordinance cannot be drafted that is compatible with the legalistic approach to controlling air pollution preferred by every jurisdiction. Thus, emphasis in the development of the recommended form of the model ordinance was given to a conceptual framework that would promote the most efficient solutions to community odor problems given the existing state of knowledge.

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The overall responsibility of this study was undertaken by Mr. R. David Flesh, Director, Environmental Economics, Copley International Corporation. Others who contributed to this reported included:

- Dr. Amos Turk, Project Consultant and Professor, City College of the City University of New York.
- Messrs. James C. Burns, Senior Staff Chemist; and F. M. Cohn, Vice President; of Pope, Evans and Robbins, Inc.
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TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS AND CONTRIBUTIONS i

LIST OF TABLES v

LIST OF FIGURES vii

CHAPTER

I INTRODUCTION 1

- FIRST AND SECOND PHASES OF RESEARCH 2
- DEVELOPMENT AND EVALUATION OF A MODEL ORDINANCE 4
- REFERENCES 7

II DEVELOPMENT OF A MODEL ORDINANCE 9

- LOGICAL EXTREMES OF ODOR CONTROL 9
- PROCEDURES FOR THE ESTABLISHMENT OF A VIOLATION 11
- STEPS IN THE DEVELOPMENT OF A MODEL ORDINANCE 16
- NOTES 18
- REFERENCES 19

III EVALUATION OF A MODEL ORDINANCE 21

- SELECTION OF THE AGENCIES 21
- PERIOD AND RESULTS OF FIELD ACTIVITIES 22
- EVALUATION OF THE PROCEDURES AND TENTATIVE MODEL ORDINANCE 30
- NOTES 40

TABLE OF CONTENTS (Cont'd)

Page

CHAPTER

IV CONCLUSIONS AND RECOMMENDATIONS 41

CONCLUSIONS PERTAINING TO THE PROCEDURES . . 41
CONCLUSIONS PERTAINING TO THE MODEL ORDINANCE 47
OTHER CONCLUSIONS 49
RECOMMENDATIONS 50
REFERENCES 53

APPENDICES 55

APPENDIX

A SUMMARY OF ODOR CONTROL REGULATIONS ENFORCED BY 203 STATE AND LOCAL AIR POLLUTION CONTROL AGENCIES 57

B REQUIREMENTS FOR AGENCY PARTICIPATION 111

C INTERVIEW EXAMPLES USED TO TRAIN AGENCY PERSONNEL 115

D EVALUATION FORM 123

PROCEDURE MANUAL 145

LIST OF TABLES

Table Page

CHAPTER III

1 Comparison of socioeconomic characteristics of test and control areas surveyed by participating agencies 24

2 Public attitude survey information obtained by participating agencies for problem identification purposes 25

3 Number of odor complaints to participating agencies against sources suspected by agencies of causing odor problems in test areas (January 1972 through September 1972) 26

CHAPTER IV

4 Sequential sampling plan based on the proportion of residents in a combination of Houston control areas who stated they were bothered by odors (AOL = 0.233, OPL = 0.433, $\alpha = 0.05$, $\beta = 0.05$) 43

5 Sequential sampling plan based on the proportion of residents in a combination of Hillsborough County control areas who stated they were bothered by odors (AOL = 0.086, OPL = 0.247, $\alpha = 0.05$, $\beta = 0.05$) 43

6 Sequential sampling plan based on the proportion of residents in a combination of Oregon control areas who stated they were bothered by odors (AOL = 0.167, OPL = 0.353, $\alpha = 0.05$, $\beta = 0.05$) 44

7 Sequential sampling plan based on the proportion of residents in a combination of Maryland control areas who stated they were bothered by odors (AOL = 0.097, OPL = 0.260, $\alpha = 0.05$, $\beta = 0.05$) 44

LIST OF TABLES (Cont'd)

Table Page

CHAPTER IV (Cont'd)

8 Time that could have been saved by the use of a sequential sampling technique in surveying test areas in which community odor problems were identified 45

LIST OF FIGURES

Figure | Page

CHAPTER II

1 Stages of odor development 12

2 Tentative form of a model odor control ordinance (March 1972 revision) 17

CHAPTER III

3 Location of industrial complex and test area where City of Houston Department of Public Health conducted odor judgment panel evaluations 28

4 Mean odor intensity isopleths obtained by Hillsborough County Environmental Protection Commission by deployment of an odor judgment panel in a small test area near Tampa, Florida 29

5 Modified scentometer system devised by the City of Houston Department of Public Health 34

CHAPTER IV

6 Comparison of median home value and percent of respondents who were bothered by odors in test areas surveyed by the participating agencies 51

7 Comparison of median home value and percent of respondents who were bothered by odors in control areas surveyed by the participating agencies 51

8 Comparison of the percentage of respondents who noticed odors with the percentage of respondents who were bothered by odors in test areas surveyed by Copley International Corporation and the participating agencies 52

CHAPTER I

INTRODUCTION

Since the 1950's many advances have been made in the development of air pollution controls, with legal controls preceding and often forcing the development of technological controls. In this sequence of events the effectiveness of the legal controls is the critical thing. It rests largely on the availability of equipment to measure concentrations of pollutants and the existence of methodology to quantify the impact of these pollutants on human health and welfare. Legal controls are particularly effective when equipment can measure pollutants to concentrations at which impact is determined to be unlikely.

Progress toward the development of controls over all forms of air pollution has not been consistent. For example, the development of odor controls has been encumbered by two major obstacles arising from the very nature of odor perception:

(1) The lack of equipment capable of measuring low concentrations of more than a few odorous substances and, coupled with this, the lack of methodology for translating known concentrations of such substances into odor intensities.

(2) The lack of methodology for quantifying impact in terms of odor intensities.

These obstacles have been particularly frustrating to enforcement authorities whose job it is to relieve countless localized and widespread community odor problems. The magnitude of their frustration can be imagined with knowledge that in many jurisdictions the number of complaints about odors has approached the number of complaints about all other forms of air pollution. In all but a few jurisdictions, however, research against these obstacles has been left for the federal government to undertake.

Under the Air Quality Act of 1967 and the Clean Air Amendments of 1970, the federal government embarked on a program to amass information relating to the sources, effects, measurements, and controls of odors and other acknowledged air pollutants. Numerous studies have already been performed under this program, including the national survey of the odor problem, conducted in 1969; a study of the social and economic impact of odors, conducted in 1970 and 1971; and the present study, conducted in 1972. These studies investigated methods of identifying and assessing community odor problems and culminated in the preparation of a model odor control ordinance based on measurable impact. The studies were conducted by Copley International Corporation for the Environmental Protection Agency under contracts CPA 22-69-50, CPA 70-116, and 68-02-0095.

FIRST AND SECOND PHASES OF RESEARCH

National Survey of the Odor Problem

The overall objective of the first phase of research was an assessment of the national odor problem using projections of the results of investigations in a selected sample of potential odor problem areas. The presence of an odor problem was found to be dependent upon the existence of an odorous substance (or substances) emitted by a source (or sources), an odor receptor population, and a mechanism to transport the former to the latter. Thus, in order to assess the national odor problem, it was necessary to identify populated areas throughout the United States with coincidence of high levels of three basic factors:

(1) Industrial odor producing potential, represented by the number of operating industrial plants weighted by relative size of plant and detectability of odorants produced.

(2) Potential extent of odor reception, represented by the size of the population affected.

(3) Atmospheric vulnerability, represented by a composite of the major causes of impaired atmospheric dilution capacity.

A sample of seven metropolitan areas was selected from a list of 31 found to rank high in these factors. The selection process took into consideration the need for nationwide representation of the study results and detailed information on likely odor problems solicited from the local air pollution control agencies. At least one community in each of the seven metropolitan areas was evaluated using ambient air dilution devices called scentometers to measure the intensity and areal extent of odors detected. In one of the seven metropolitan areas — Philadelphia, PA — an odor judgment panel was employed to determine intensity patterns of odors caused by an oil refinery and an animal rendering plant.

Lengthy public attitude surveys were conducted as an exploratory approach to determine how community odors affect people. The surveys were designed to determine if people are generally aware of odors in their communities, if the public is interested in the abatement of odors, if people believe they have suffered socially or economically because of odors, and if differences in opinion about odors exist between people living and working in suspected odor problem communities (test areas) and those living and working in odor free communities (control areas).

The results of the study indicated that, although industrial odor producing potential exists in most metropolitan areas of the United States, the probability of encountering community odor problems is greater in the urban portions of the Appalachian and Rocky Mountain Regions and the California Coastal Zone. Projecting the results of the attitude surveys to the nation as a whole suggested that as many as 25 million residents perceived community odors as problems.

Social and Economic Impact of Odors

The main objective of the second phase of research was the development of procedures to identify community odor problems and to assess their social and economic impact. As in the first phase, a metropolitan area was selected from the list of potential odor problem areas. The areas were established near a variety of sources to permit a comparison of the effects of odors having vastly different qualities.

Public attitude surveys and technical field studies were conducted in December 1970, March 1971, and June 1971. The public attitude surveys were designed to obtain data relative to the influence of odors on the attitudes of residents. Small sample sizes were used to determine whether the survey method could be used to obtain quick and decisive answers about the existence of a variety of possible odor problems. The technical field studies were to employ sensory techniques to systematically measure the intensity, duration, frequency, and temporal variation of odors for correlation with the results of the quarterly surveys and to further compare the operational features of the techniques used in the Philadelphia investigation.

It was expected that the national survey of the odor problem and the study of the social and economic impact of odors would provide a series of relationships that could be used in the development of legal controls over odors. Yet, as this and other research progressed, it became evident that the only measurable impact associated with a vast majority of odor problems was annoyance and that a proper means for dealing with such problems must consider the measurement of annoyance as central to success. Public attitude surveys were recommended as the proper means for doing so.

To simplify the requirements for odor problem identification, consideration was given to the elimination of surveys in control areas. The best possibility of doing so was found by combining the results from the control areas previously investigated. Preliminary attempts indicated that the same combined results could be used to reduce the effort required to survey test areas. This reduction of survey effort seems possible through sequential analysis under which one of three decisions can be made:

(1) That an odor problem is identified.

(2) That an odor problem does not exist.

(3) That the results are inconclusive and that an additional interview must be completed.

Availability of Final Reports

Further details of the first and second phases of research may be obtained by reference to the final reports listed at the conclusion of this chapter.

DEVELOPMENT AND EVALUATION OF A MODEL ORDINANCE

Objectives and Methodology

The ultimate objective of the present study was the preparation of a model odor control ordinance that could be adopted and applied effectively by enforcement authorities throughout the United States. To meet this objective the following tasks were undertaken:

(1) Preparation of a tentative form of a model ordinance.

(2) Selection of four air pollution control agencies to evaluate the procedures developed in the second phase of research along with the model ordinance.

(3) Instruction of employees of the selected agencies in the proper use of the procedures in relation to the model ordinance.

(4) Guidance of selected agencies' project related field activities.

(5) Refinement of the procedures and the model ordinance for submission to the Environmental Protection Agency.

The tentative form of the model odor control ordinance was prepared from the responses of enforcement authorities solicited during the first and second phases of research, a thorough review of pertinent legal controls proposed in recent literature, and an analysis of existing and proposed odor control regulations obtained from 203 jurisdictions. Following the conclusions of the study of the social and economic impact of odors, it was intended that the model ordinance be made consistent with public nuisance law.

Selection of the agencies for participation in the study was based on level of government, geographic location, and interest in the study and control of odor problems. In addition, the officials in charge had to agree to complete minimal requirements as described in a detailed work plan. Final selection included:

- City of Houston (Texas) Department of Public Health
- Hillsborough County (Florida) Environmental Protection Commission
- Columbia-Willamette (Oregon) Air Pollution Authority
- State of Maryland Bureau of Air Quality Control

Prior to the beginning of the field activities, representatives of Copley International Corporation and Pope, Evans and Robbins, Inc., instructed agency employees, especially in the conduct of public attitude surveys and the use of sensory techniques. The field activities were continued for a period of eight months and were directed by agency officials alone. CIC and PER maintained advisory roles. Questions posed by any of the agencies, along with the responses of CIC and PER, were communicated to all of the agencies through a series of project letters.

Upon conclusion of the field activities, the procedures were evaluated by agency employees in terms of ease of use, the information obtained in relation to agency needs, and the costs involved. The structure and content of the tentative form of the model ordinance were examined by agency attorneys.

Principal Findings of the Present Study

All modifications to the procedures and tentative model ordinance recommended by the four participating agencies were considered. Many involved simple refinements and were implemented without comment. Others, such as the following, are discussed at length in this report.

The agencies held different opinions about various aspects of the applicability of the procedures. However, most of the agencies felt that the procedures were not applicable to sparsely populated communities in which only a few homes are affected and to the measurement of the undesirable effects of odor on commercial or industrial groups. Most of the agencies also felt that some of the tasks, particularly the delineation of test and control areas and the training and deployment of an odor judgment panel, are too cumbersome for routine application.

The first of these points is acknowledged. Without resorting to a complex analysis of small sample sizes, the residents of at least 20 (and preferably 30) homes in each area must be successfully interviewed. The second point is not considered a shortcoming. Based on the results of the national survey of the odor problem, the procedures were designed for use in measuring the undesirable effects of odor on the most sensitive community group — residents. It is further acknowledged that certain tasks are too cumbersome for purposes of routine surveillance of chronic situations. However, three conditions were written into the procedures (and the tentative model ordinance) to limit their use to possible odor problems.

The agencies had more critical comments about the tentative form of the model ordinance. For example, it was felt the model ordinance does not protect small portions of the population and does not provide for the accused to be confronted by his accusers. One of the agencies felt that the need to compare areas of "similar socioeconomic characteristics" may give rise to discriminatory application of the law among different socioeconomic classes.

That the model ordinance is not applicable to small portions of the population, i.e., to residents of less than 20 homes, is again acknowledged. The model ordinance is consistent with public nuisance law if it can be agreed that "any considerable number of persons" must include the residents of at least 20 homes. It was not intended for the model ordinance to be applied for private means. The difficulty of getting many test area residents to appear in court as accusers seemingly would be inversely related to the magnitude of the odor problem in their community. It may be partly or totally avoided by the use of a sequential sampling technique or by adoption of the model ordinance as a statute, rather than enactment as a form of public nuisance law.

The need to match a control area to a test area by reference to the socioeconomic characteristics of the test area is only to insure that the population of the control area would be a reasonable representation of the population of the test area. As a consequence, a measurement of the attitudes of the residents of the control area as a group would be a reasonable representation of the attitudes of the residents of the test area as a group, except for any effect on the attitudes of the latter group that is due to the presence of odors in the test area. The possibility that such a comparison may give rise to discriminatory application is academic in this context.

Conclusions based on the experiences of all four agencies include the following. Although the procedures cannot be applied, without modification, to possible odor problems in residential areas of less than 20 homes or in commercial or industrial areas, it is estimated that they can be successfully applied to at least 80 percent of all possible odor problems. Much time can be saved in applying the procedures by use of a professional real estate appraiser in the location of suitable control areas and by use of a sequential sampling technique when conducting public attitude surveys. The use of an odor judgment panel is best left to special circumstances where legal liability or compliance questions require explicit documentation of odorous emissions.

From the evaluations of the participating agencies and from a review of the odor control regulations of 203 jurisdictions, it is concluded that a model ordinance cannot be drafted that is compatible with the legalistic approach to controlling air pollution preferred by every jurisdiction. Thus, emphasis in the development of the recommended form of the model ordinance was given to a conceptual framework that would promote the most efficient solutions to community odor problems given the existing state of knowledge.

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CHAPTER II

DEVELOPMENT OF A MODEL ORDINANCE

This chapter is divided into three sections concerned with the composition of an odor control ordinance. The initial section presents a brief discussion of two theses which represent the logical extremes of odor control and which are believed to be appropriate for consideration in any highly developed society:

(1) That odor is not acceptable.
(2) That undesirable effects of odor are not acceptable.

Five procedures for the establishment of a violation are then compared in the second section of this chapter:

(1) Measurement of odor intensity at the source.
(2) Measurement of key odorants at the source.
(3) Measurement of odor intensity in the ambient air.
(4) Measurement of key odorants in the ambient air.
(5) Measurement of the undesirable effects of odor.

The final section outlines the steps in the development of a model ordinance based on the latter thesis under the present study.

LOGICAL EXTREMES OF ODOR CONTROL

As was reported at length in the national survey of the odor problem, enforcement authorities throughout the nation have urgent need for an effective odor control ordinance. Most of them were quick to admit this need and equally quick to suggest what would be an "effective" odor law:

(1) It would be clear in intent.

(2) It would be applicable to all odor sources, with provisions for exceptions to be handled individually.

(3) It would specify a procedure for the establishment of a violation that would be not only simple and inexpensive to administer, but also recognized by the courts as a means for obtaining conclusive information.

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(4) It would provide all potential offenders with a specific goal for compliance.

In short, an effective odor law would promote administrative efficiency. Although idealistic as a whole, this suggestion reflects the reality that resources are scarce for use in any comprehensive air quality control program.

Considering this suggestion, it is not surprising that enforcement authorities have rejected numerous proposals by researchers, which require complex and laborious investigations and which, in the final analysis, seem arbitrary for deciding whether or not human health or welfare has been impaired. Neither is it surprising that they have discredited the use of complaint information which is often unreliable and, instead, have turned toward the thesis that odor is not acceptable to society.[1]

The advantages of a no-odor ordinance are obvious. It is clear in intent and universally applicable. One regulatory agency employee or, at worst, a small panel of agency representatives can be used to decide whether or not a violation exists. Dilution equipment may be required, but only if odors are to be evaluated from stack samples rather than in the ambient air. It provides a specific goal for compliance.

The drawbacks of a no-odor ordinance are not so obvious. Most importantly, the validity of the thesis has never been established. In addition, the courts must permit discretionary application; otherwise, resources must be consumed in the investigation of every alleged odor in town.

That it is difficult to develop an effective odor control ordinance might be imagined by noting the variety of existing and proposed regulations summarized in Appendix A of this report. It is felt that part of this difficulty is due to a widespread misconception of odor itself, which is manifest in the classification of odor as a form of air pollution. Odor is not a form of air pollution; it is an effect of air pollution. Thus, odor was defined at a recent international symposium on environmental health as "the product of the activation of the sense of smell, an olfactory experience," caused by "any chemical compound which can stimulate the olfactory (smell) sense."[2]

It is felt that a further part of this difficulty is the tendency of many persons to equate the perception of odor with the existence of a problem. Rather, it is personal evaluations of those who perceive odor, not the mere activation of the sense of smell, which may give rise to the problem dimension. This distinction is necessary to explain why some odors are considered pleasant, while other odors or the same odors experienced under different conditions are considered unpleasant even to the extent of causing undesirable (secondary) effects such as feelings of annoyance.

As the study of the social and economic impact of odors and other research progressed, it became evident that the most measurable impact associated with a vast majority of odor problems was annoyance.[3] In fact, while bother from odors was found in some test areas without other undesirable effects being detected, the reverse was never encountered. This evidence suggested that a proper means for dealing with such problems would be a law developed on the thesis that undesirable effects of odor are unacceptable to society. The measurement of annoyance would serve as a convenient indicator of the existence of undesirable effects and, thus, as a basis for deciding whether or not a violation exists.

There are several advantages to a no-ill-effects ordinance. Although the intent of such an ordinance may be more difficult to understand, it is universally applicable. Measurements would be aimed at the problem dimension. Since at least the fifteenth century A.D., sources of annoyance to any considerable number of persons have been recognized by the courts as illegal under the tenets of public nuisance law. The focus of technological controls on the annoyance threshold rather than the odor threshold would very likely result in more efficient solutions when taking into account the societal consideration that the added cost of control should equal the added benefit derived from that control.

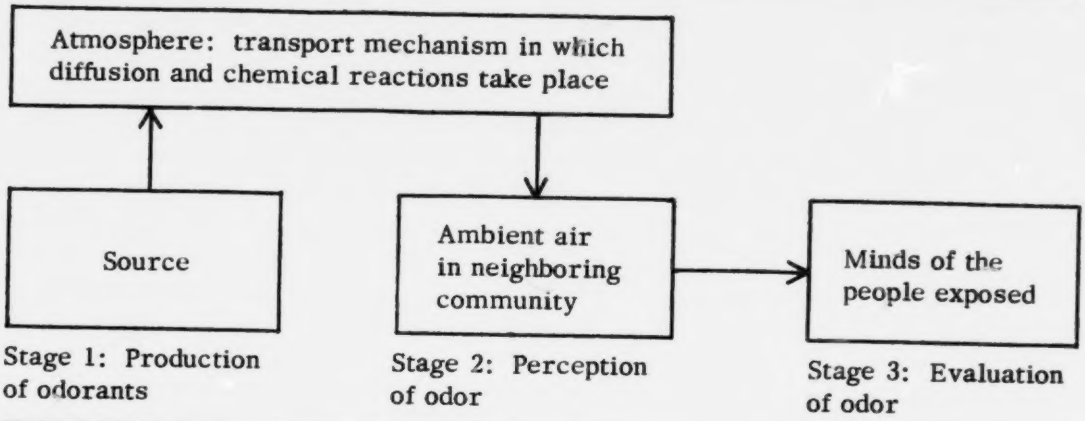
There are also several drawbacks to such an ordinance. Most regulatory agencies would have to acquire new skills in the use of behavioral science techniques. While these techniques are no more complex than many traditional techniques used in the evaluation of odors or odorous substances, they are not yet recognized by the courts as a means for obtaining conclusive information. In addition, the adoption of this thesis would not give offending sources a specific goal for compliance.

PROCEDURES FOR THE ESTABLISHMENT OF A VIOLATION

Regardless of the odor control thesis adopted, a procedure must be specified for the establishment of a violation. As shown in Figure 1, there are three distinct stages in the series of events beginning with the production of odorous substances (odorants) at a given source and ending with the culmination of effects on the people in the neighboring community. Five such procedures, involving measurements at the stages depicted, are discussed below. Each has the scientific endorsement of various researchers.

Other possible procedures exist, such as the use of complaint information, which may be simpler and cheaper to administer but lack scientific merit. These possibilities are not included in this report.[4]

Figure 1. Stages of odor development.


Atmosphere: transport mechanism in which diffusion and chemical reactions take place
Source
Ambient air in neighboring community
Minds of the people exposed
Stage 1: Production of odorants
Stage 2: Perception of odor
Stage 3: Evaluation of odor

Measurements at the Source (Stage 1)

Procedures involving measurements at the source do not provide a direct appraisal of any undesirable effects arising in Stage 3. Ideally, such procedures are used with knowledge of what levels of odorants are associated with the occurrence of undesirable effects in the neighboring community.

Diffusion modeling has been employed to predict the dilution between Stages 1 and 2 under various conditions. In doing so, it has been necessary to consider the interactions between different emissions as well as average stack height, average distance from source to community, and average meteorological conditions. From these inputs, average dilution figures have been obtained. Diffusion modeling has also been employed to provide more precise dilution figures for a given source under given sets of input conditions.

Because odors are often encountered well beyond the distances predicted by the diffusion models, safety factors have often been included in the estimates of dilution capacity. The disparities between empirical results and the diffusion models are thought to be due to reactions of the odorants in transit, such as adsorption on particulates, or to transient peaks that initiate nuisance responses.

Despite the limitations alluded to above, measurements at the source offer special advantages. They are closest to the point at which odor abatement equipment usually operates. Thus, they provide the fastest and most direct feedback information for abatement purposes. In addition, although an emission may contain many chemical substances, only a few may contribute to any odor the emission may cause. The identification and continued monitoring of key odorants may be possible from concentrated samples obtained at the source, while it may not yet be possible to do so from less concentrated samples taken from the ambient air.

Measurement of Odor Intensity at the Source. This procedure requires the collection of a sample for sensory evaluation. Although direct sensory evaluation of emissions is precluded because of the high odor intensities, high temperatures, and toxicity of the emissions that are usually encountered, indirect measurement of odor intensity can be achieved safely through the controlled distribution of a sample. The benefit of this safety feature may be offset, however, by chemical and physical reactions that occur within the sample.

The odor characteristics of a sample may change because of the inherent instability of many highly odorous substances, the interactions of the odorants with the container walls or with other substances that may be present, or physical changes such as cooling which may produce condensation and draw some odorants into solution. To avoid, or at least to minimize these changes, the sampling process must be carefully chosen and monitored. One popular method of monitoring is chromatographic analysis which is performed immediately upon collection of the sample and repeated just before subsequent dilution for sensory evaluation.

After a sample is collected, a measurement of odor intensity is obtained in an odor free environment by a panel of trained judges. The panelists have been previously screened with reference standards to establish that they possess an adequate sense of smell and a high degree of reproducibility in judging odors of similar quality to those caused by the source under investigation. The measurement is performed either by computing the number of volumes of odor free air necessary to reach the recognition odor threshold (i.e., the lowest intensity at which a panelist can positively identify the odor quality of the sample) or by comparing the sample to an odor intensity reference standard scale. When this is completed, the amount of dilution with odor free air necessary to reduce the odor intensity of the sample to a desired level can be determined.

Either static or dynamic dilution to threshold techniques can be used in this work. Static techniques involve the preparation of fixed dilutions for separate presentation to the panelists. Dynamic techniques employ a device for selected mixing of deodorized air with a collected sample for almost continuous presentation to the panelists or to the operators of the device.[5]

It is noted that the adoption of procedures for the measurement of odor intensities at the source is a fairly recent occurrence. However, sensory evaluations have been performed occasionally for many years in connection with the odor reduction efficiency of certain abatement devices.

Measurement of Key Odorants at the Source. This approach is more attractive to regulatory agencies and industry since sensory evaluations are not involved. Instrumentation can be adapted to deal with high temperatures, and instruments are unaffected by high odor intensities or toxicity. However, this approach suffers from not dealing with odors directly and from reliance on two questionable assumptions:

(1) That the composition of an emission is fairly constant and, as a result, the substances identified as key odorants and selected for monitoring remain the key odorants at all times.

(2) That any equipment used to abate the key odorants will be equally effective in removing the minor odorants entrained in the emission.

Considerable exploratory work must be done unless the emissions of the source under investigation are well known. Once the key odorants and their concentrations have been identified, analytical methods must be developed to measure them without obtaining erroneous results due to interferences from other substances that may be present. If the analytical method devised is suitable for automation, the key odorants can be monitored continuously with minimum attention. However, in many cases this is not possible and more tedious wet-chemical analyses give the only alternative. In such cases, the attractiveness of the approach is seriously diminished.

To date, this procedure has been adopted by only one agency for use beginning in Fall 1973. Consequently, its effectiveness must be reported here as unknown.

Measurements in the Ambient Air (Stage 2)

Ambient odor measurements are generally direct sensory evaluations unhindered by high intensity, high temperature, and toxicity constraints. However, such measurements still do not reflect any undesirable effects arising in Stage 3. Procedures involving such measurements are best used with knowledge of what levels of odors are associated with the occurrence of undesirable effects in the neighboring community.

Measurement of Odor Intensity in the Ambient Air. This procedure also depends on sensory evaluation. Once again, the measurement is performed either by computing the number of volumes of odor free air necessary to reach the recognition odor threshold or by comparing the intensity of the odor to a reference standard scale. To date, most ambient air investigations have used the dilution to threshold option.[6]

The way in which the dilution is performed is particularly important with ambient odor measurements because of the transient nature of the odors. The diffusion which occurs between the source and the neighboring community often causes the odorants to be distributed in the air in a manner that a trained judge placed in the area perceives the odor as a series of pulses, each lasting only a few seconds, even when the emissions from the source are continuous and fairly constant in composition and concentration.

Thus, when choosing a dilution method it is important to consider whether average or peak values are to be obtained. If average values are of importance, the air must be sampled over a significant period of time. The sample is then used for sensory evaluation. If peak values are of importance, a dilution device must be set to permit mixing of large volumes of deodorized air with ambient air so that only the presence or absence of peaks can be detected. The detection of peaks rather than the measurement of average values is preferred in communities where transient odors are encountered.

A practical procedure for using a dilution device to establish violations of prescribed ambient odor limits is to adjust the device so that only one dilution level is used, which would permit the detection of any odor of an intensity beyond that prescribed. By monitoring the diluted air in this manner, a violation is recorded whenever odor is perceived. Several enforcement authorities presently use this approach.

The option of comparing ambient odor intensities to a reference standard scale is best suited for use with transient odors. In this way, the measurement of peak values can be achieved without the danger that odors of constant intensity might cause a reduction in the sensitivity of the panel of trained judges. Because of the ability of judges to respond to abrupt changes in odor intensity, this method has been used successfully to describe odor distribution patterns in test areas. However, this approach has not been used for the establishment of a violation because of the additional work involved in preparing reference standards. Fear of uncertainty in accurately evaluating odor intensities away from the laboratory environment in the variable background conditions which are encountered in test areas has also been a factor.

Measurement of Key Odorants in the Ambient Air. Research is being conducted into methods for measuring ambient concentrations of various chemical substances. A procedure for the measurement of key odorants in the ambient air seems possible for odorants that can be measured down to concentrations corresponding to the odor recognition threshold. At present, no such procedure exists.

Measurement of Undesirable Effects (Stage 3)

Undesirable (secondary) effects of substances that activate the sense of smell include feelings of annoyance, discomfort, and repulsion. These are exhibited in complaints and, in extreme cases, more costly actions such as seeking medical assistance, refusing to conduct business in a community, or moving away from a community. As mentioned above with regard to previous research, while annoyance due to odors was found in some test areas without other undesirable effects being detected, the reverse was never encountered. The measurement of annoyance would serve as a convenient indicator of the existence of undesirable effects and, thus, a procedure for the measurement of annoyance would provide a means for deciding whether or not a violation exists.

A few approaches have been advanced, especially by regulatory agencies, for gauging malcontent in communities affected by odors. However, to the extent that they rely on certain numbers of voluntary complaints from persons who purport to be bothered by odor or to the extent that they specify an arbitrary percentage of persons in a community to be bothered by odors for a violation to be established, such approaches are without scientific support. Although the techniques of measurement are chosen with a proper concern for viewing the problem dimension at Stage 3, they do not provide assurance that any outcomes attained reflect the true feelings of those who have complained or of those who may have been polled. In short, they produce outcomes that are totally subjective. There is, however, a procedure for the measurement of annoyance that, within a known probability of error, does provide scientific support in the establishment of a violation. Major aspects of this procedure are described in the remaining chapters of this report.

STEPS IN THE DEVELOPMENT OF A MODEL ORDINANCE

A tentative model ordinance against undesirable effects of odor was prepared under the present study from the following sources of information:

- The responses of regulatory agencies to questions relating to odor control measures that were collected by Copley International Corporation under the first phase of research.
- The opinions and suggestions of regulatory agency officials expressed informally to representatives of CIC and Pope, Evans and Robbins, Inc., during the second phase of research.
- A thorough review of proposed odor control ordinances published in recent literature.
- A thorough review of existing and proposed odor control ordinances obtained from 203 state and local air pollution control agencies throughout the nation.

It was from the latter source of information that the tentative structure was formulated. Copies of existing and proposed ordinances were obtained by mail. A summary of the condition(s) necessary for violation and the prohibition(s) and control requirement(s) specified in the ordinances supplied by these agencies is presented in Appendix A.

As shown in Figure 2, the tentative structure contained three sections stating definitions, the general provision, and the procedural establishment of a violation. Three of the six definitions — viz., "chronic situation," "community odor problem," and "odor free community" — were aimed at the specialized terminology of the "Procedures for the Identification and Assessment of Community

Figure 2. Tentative form of a model odor control ordinance (March 1972 revision).

SECTION I - DEFINITIONS

Chronic Situation - A causation of odors to persons beyond the property limits of a source occurring more than once or lasting more than one day in any three month period. Causation shall infer continued emission of odorous substances into the atmosphere by the source, not merely a result of impaired atmospheric dilution capacity.

Community Odor Problem - A condition which is said to exist when it has been determined, by public attitude surveys of randomly selected samples of residents, that a significantly greater proportion of respondents in a community state they were bothered by odors than respondents of an odor free community of similar socioeconomic characteristics.

Odor - Perception of smell, referring to the experience.

Odor Free Community - A community from which no odor complaints have been received by local authorities and in which no odors have been detected by local authorities during the past twelve months.

Odorous Substance - A substance that stimulates the olfactory receptors and, thus, causes odor.

Person - Any person, firm, association, organization, partnership, business trust, corporation, company, contractor, supplier, installer, user, or owner, or any state or local governmental agency or public district, or any officer, agent, or employee thereof.

SECTION II - GENERAL PROVISION

No person shall permit, cause, suffer, or allow the emission of odorous substances into the atmosphere that would result in a community odor problem from any source under his control.

SECTION III - PROCEDURAL ESTABLISHMENT OF A VIOLATION

Violation of this ordinance shall be established by identification of a community odor problem. Such identification shall be undertaken by the air quality enforcement agency serving this jurisdiction in accordance with the "Procedures for the Identification and Assessment of Community Odor Problems," prepared for the Environmental Protection Agency under Contract No. CPA 70-116, dated November 1971.*

Odor problem identification shall require:

(A) the existence of a chronic situation as defined in SECTION I of this ordinance, and

(B) the existence of any of the following conditions:

(1) if one or more odor complaints are initiated by residents of a community and verified by local authorities after the first day of the first occurrence in any three month period, or

(2) if twenty or more odor complaints are initiated by residents of a community, but not verified by local authorities after the first day of the first occurrence in any three month period, or

(3) if odors are detected in a community by local authorities on more than one day in any three month period (such odors shall be of sufficient intensity to be detected using a Barnebey-Cheney Model I-3 Scentometer set at 7 dilutions to threshold), and

(C) the determination, by public attitude surveys of randomly selected samples of adult residents, that a significantly greater proportion of respondents in the community state they were bothered by odors than respondents in an odor free community of similar socioeconomic characteristics.

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*These procedures may be found in the last section of the final report of the second phase of research. They are essentially identical to those provided in the last section of this report.

Odor Problems," which were incorporated by reference. The remaining definitions and the general provision were modeled after those obtained by mail. The procedural establishment of a violation was intended to be consistent with public nuisance law. However, rather than to rely solely on the expressions of annoyance of "any considerable number of persons," this section was made to further require comparative measurements of annoyance in test areas and matching control areas in order to ensure the objectivity of any results obtained.

Extensive evaluations of this proposed regulation were conducted by the legal staffs of four air pollution control agencies. The criteria used in the selection of these agencies and the substance of their evaluations are discussed in the next chapter.

NOTES

[1] An excellent example of interest in a no-odor ordinance is found in a proposed "Regulation VI, Control of Emissions of Odors From Stationary and Mobile Sources," dated September 2, 1971. This proposed ordinance was developed by the Air Management Services, City of Philadelphia, Department of Public Health. The general provision stated that, "No person shall permit, cause, suffer, or allow the escape of odor, as defined in Section I of this Regulation, to the atmosphere." Odor was defined in Section I as, "Smells or aromas which are unpleasant to persons, or which tend to lessen human food and water intake, interfere with sleep, upset appetite, produce irritation of the upper respiratory tract, or create symptoms of nausea, or which by their inherent chemical or physical nature, or method of processing, are or may be detrimental or dangerous to health. Odors and smell are used herein interchangeably." Finally, the procedural determination of an odor violation stated that, "A scent shall be a violation of this Regulation when a certified agent of the Department senses this scent and determines it to be an odor."

[2] The Third Karolinska Institute Symposium on Environmental Health, "Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air," Nordisk Hygienisk Tidskrift, LI (1970), 16.

[3] This evidence is consistent with the Symposium finding that, "In environmental health the most important dimension of an odor is probably its acceptability, e.g., what percentage of the population is annoyed by the smell." Ibid., 30.

[4] The use of complaint information is criticized in the final report of the study of the social and economic impact of odors.

[5] Among the most widely recognized methods for the measurement of odor intensity from samples obtained at the source are the static techniques of the American Society for Testing and Materials, Benforado et al., Mills et al., and

Turk and the dynamic techniques of Hemeon Associates and Sanders et al. With regard to the dynamic techniques, the vapor dilution devices developed by Hemeon Associates and Sanders et al. are sufficiently portable to permit sensory evaluations in the field.

[6] The measurement of odor intensity in the ambient air has been accomplished on numerous occasions by Pope, Evans and Robbins, Inc., using the dynamic technique of Huey et al. and the odor judgment panel technique of Turk.

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CHAPTER III

EVALUATION OF A MODEL ORDINANCE

To achieve the ultimate objective of the present study, it was necessary to select a few air pollution control agencies to appraise the usefulness of the "Procedures for the Identification and Assessment of Community Odor Problems" as a means for deciding whether or not violations exist. Because of the preliminary stage at which the tentative version of the model odor control ordinance was supplied to these agencies and because there was insufficient time to tailor it to the legislative customs of their respective jurisdictions, the model ordinance was not enacted. Neither was it nor were the results obtained from applying the procedures to actual chronic situations given to the courts for review and opinion. Instead, the evaluations were made the responsibility of the technical and legal staffs of the agencies themselves.

The purpose of this chapter is to highlight these evaluations. The chapter is divided into three sections. The first section describes the selection of the agencies to participate in the study. The second section establishes the context from which each agency drafted its evaluation. The substance of the evaluations is then presented.

SELECTION OF THE AGENCIES

The following criteria were used in the selection of agencies for participation in the evaluation program:

- First consideration was given to geographic location. Although representation of different regions of the United States was thought important, location in metropolitan areas having numerous possible community odor problems was thought most important.

- Following this, only agencies with known involvement in the study and control of community odor problems were contacted.

- Of those contacted, agencies with an initial interest in the program were sent the requirements for participation and detailed work plan shown in Appendix B. Selection was made among agencies whose directors expressed willingness to complete these requirements.

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- Last consideration was given to the level of government at which the agencies served the public. While the procedures were meant to be applicable to the needs of all agencies operating at the local level, it was thought desirable to ensure this applicability.

Information obtained during the national survey of the odor problem and the study of the social and economic impact of odors made easy the satisfaction of the first two criteria. Fifteen agencies were contacted and acquainted with the purpose and scope of the program. Several agencies, although interested, declined to participate owing to a shortage of available manpower. Others, largely for reasons discussed in Chapter II, had adopted the thesis that odor is not acceptable to society and were not open to alternate proposals.

Eight agencies were sent the requirements for participation along with copies of the tentative form of the model ordinance and the procedures. Four of these were finally selected:

- City of Houston (Texas) Department of Public Health
- Hillsborough County (Florida) Environmental Protection Commission
- Columbia-Willamette (Oregon) Air Pollution Authority
- State of Maryland Bureau of Air Quality Control

It is noted that they represented progressively higher levels of government, including a city, county, multicounty (or regional), and state authority.

Prior to the beginning of the project related field activities, representatives of Copley International Corporation and Pope, Evans and Robbins, Inc., instructed agency employees in performing such procedural tasks as the delineation of test and control areas, analysis of public attitude survey results, proper use of the scentometer, and training and deployment of odor judgment panelists. Simulated telephone interviews were used to train agency employees in preparation for conducting public attitude surveys. Transcribed examples of these interviews are given in Appendix C. In addition to providing instructional assistance to the agencies, these meetings provided CIC and PER with assurance that the agencies possessed the skills necessary to complete the requirements of the program.

PERIOD AND RESULTS OF FIELD ACTIVITIES

The field activities began in January 1972. They were planned to continue for a period of six months during which time each agency was to conduct a minimum of six sets of surveys (i.e., six surveys in test areas and six in matching control areas) in accordance with the procedure for problem identification. Source verification was to be required for each test area in which an odor problem was identified. However, to compensate for an unexpected lack of odor problems during the first few months in Oregon and Maryland and to permit four additional surveys as well as odor judgment panel work to be conducted in Houston and Hillsborough County, the field activities were extended to a period of eight months.

The field activities were directed by agency officials alone. CIC and PER maintained advisory roles. Questions posed by any of the agencies, along with the responses of CIC and PER were communicated to all agencies through a series of project letters. During the eight months, a total of 26 questions were asked. The frequency distribution of the questions indicated the existence of a problem identification learning curve which, for most of the agencies, extended through the second set of public attitude surveys.

The results obtained by the agencies are mainly important to the extent that they establish the context of the subsequent evaluations. The results are summarized in Table 1, which compares the socioeconomic characteristics of the test and control areas surveyed, Table 2, which shows the survey information obtained for problem identification purposes, and Table 3, which shows the number of odor complaints made against the suspected sources during the field activities.

Each of the agencies investigated many communities in search of possible odor problems and delineated test areas in communities where the possibilities seemed greatest. Matching control areas were then located. A total of 28 sets of public attitude surveys were conducted in these areas. As can be seen in Table 2, 17 community odor problems were identified from the results of these surveys (6 by the City of Houston, 6 by Hillsborough County, 1 by Comumbia-Willamette, and 4 by the State of Maryland).

The method of source verification was not specified in the requirements for participation, although two sensory techniques — one using a Barnebey-Cheney Model I-3 Scentometer, the other employing an odor judgment panel trained to evaluate an odorized environment in terms of memorized reference standards — were described extensively in the procedure designed to assist in this undertaking.

The complexity of investigation required to prove that a particular source causes an odor perceptible to residents of a test area is primarily a function of the number and types of sources situated within a few miles radius of the test area. Where the quality of the odor is characteristic of a particular industry and where only one plant of that industry is located near the test area, the source can be easily pinpointed. However, when the quality of the odor is not well known or numerous plants are clustered near the test area, source verification can be an extremely difficult undertaking. All the odor problems identified by three of the agencies were of the former type where the agencies felt that detection of the odor followed by a brief reconnaissance of the community was sufficient to locate the source and provide positive verification. Only in Houston were the odor problems identified in the vicinity of a number of possible sources.

Table 1. Comparison of socioeconomic characteristics of test and control areas surveyed by participating agencies.

Public Attitude Survey Set No.	No. of Homes In Area		Median Income		Median Home Value		Median Gross Rent		Median No. of Rooms Per Home		Percent Homes Built In Same Category of Years	
	T. Area	C. Area	T. Area	C. Area	T. Area	C. Area	T. Area	C. Area	T. Area	C. Area	T. Area	C. Area
1	1,802	803	$ 5,633	$ 8,100	$ 8,100	$ 9,200	$ 67/mo.	$ 65/mo.	4.6	4.4	46%	32%
2	2,467	3,319	11,658	14,624*	20,200	24,400*	145	166	5.5	6.3	35	30
3	2,025	1,462	7,809	7,297	9,600	11,500	71	71	4.3	4.3	42	25
4(a)	1,391	395	11,336	10,397	12,300	10,900	87	79	5.2	5.1	75	78
5	329	107	7,807	7,661	9,600	8,800	71	81	4.3	4.5	43	30
6(c)	650	233	10,168	8,971	12,900	13,100	116	86*	4.4	4.5	32	22
7(b)	1,391	395	11,336	10,397	12,300	10,900	87	79	5.2	5.1	75	78
8(d)	650	233	10,168	8,971	12,900	13,100	116	86*	4.4	4.5	32	22
Hillsborough County Environmental Protection Commission												
1	64	73	N.A.	N.A.	$13,000	$12,000	N.A.	N.A.	5.5	5.5	N.A.	N.A.
2	48	44	N.A.	N.A.	7,750	7,750	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
3	47	47	N.A.	N.A.	14,500	16,000	N.A.	N.A.	6.5	7.0	N.A.	N.A.
4	143	179	N.A.	N.A.	12,300	12,300	N.A.	N.A.	4.9	4.9	N.A.	N.A.
5	82	81	N.A.	N.A.	100,000	100,000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
6	37	68	N.A.	N.A.	21,000	23,500	N.A.	N.A.	7.0	6.5	N.A.	N.A.
7	114	124	N.A.	N.A.	N.A.	N.A.	$270/mo.	$245/mo.	N.A.	N.A.	N.A.	N.A.
8	101	128	N.A.	N.A.	12,500	13,500	N.A.	N.A.	5.0	5.0	N.A.	N.A.
Columbia-Willamette Air Pollution Authority												
1	713	1,250	$ 6,596	$ 5,948	$15,392	$12,491	$100/mo.	$102/mo.	4.9	5.0	50%	49%
2(a)	1,259	1,481	5,877	5,963	12,766	12,670	84	102	4.6	4.9	68	67
3	1,578	1,481	6,172	5,963	13,228	12,670	84	102	5.0	4.9	53	67
4	1,334	1,210	6,833	6,827	14,922	13,450	85	87	5.1	5.5	51	85*
5(b)	1,249	1,481	5,877	5,963	12,766	12,670	84	102	4.6	4.9	68	67
6	165	1,481	5,877	5,963	12,766	12,670	84	102	4.6	4.9	68	67
State of Maryland Bureau of Air Quality Control												
1(a)	350	933	$13,557	$13,001	$20,600	$22,100	$ 89/mo.	$109/mo.*	6.5	6.1	43%	47%
2	218	1,550	8,839	11,298*	13,200	16,500*	102	91	5.3	5.7	54	29*
3	114	803	14,827	15,293	28,000	27,200	189	203	6.3	6.4	59	71
4	310	971	13,014	14,730	18,600	21,200	169	211*	5.7	6.1	53	19*
5	141	170	11,855	13,075	37,300	34,815	159	183	4.5	6.7**	96	98
6(b)	350	933	13,557	13,000	20,600	22,100	89	109*	6.5	6.1	43	47

Note: Letters shown in parentheses after the survey set numbers refer to the initial and replicate sets of surveys conducted in the same test and control areas. For each of three agencies, set b is a replicate of set a and, for one agency, set d is a replicate of set c.

Control area value differs from test area value in excess of recommended tolerance of ± 20 percent.

Control area value differs from test area value in excess of recommended tolerance of ± 10 percent.

Sources: U. S. Department of Commerce, Bureau of the Census, and estimates of professional real estate appraisers.

Table 2. Public attitude survey information obtained by participating agencies for problem identification purposes.

Public Attitude Survey Set No.	No. of Interviews Completed		No. of Respondents Who Were Bothered By Odors		Value of Normal Deviate, z*	Odor Problem Index
	Test Area	Control Area	Test Area	Control Area		
City of Houston Department of Public Health						
1	50	36	18	13	-0 01	--
2	58	44	27	12	1.98	3.8
3	51	37	25	12	1.56	--
4(a)	37	29	22	6	3.15	6.1
5	40	56	29	14	4.61	7.2
6(c)	31	36	16	7	2.79	5.7
7(b)	38	38	22	5	4.07	5.7
8(d)	29	33	15	3	3.69	6.9
Hillsborough County Environmental Protection Commission						
1	30	29	25	4	5.34	5.7
2	22	25	8	2	2.37	5.0
3	22	16	3	3	-0.43	--
4	20	30	5	3	1.42	--
5	27	27	21	3	4.75	4.1
6	21	29	9	1	3.44	8.3
7	22	23	10	0	3.66	7.0
8	30	30	10	2	2.58	3.6
Columbia-Willamette Air Pollution Authority						
1	31	30	9	5	1.15	--
2(a)	30	30	12	5	2.01	5.2
3	30	30	8	3	1.61	--
4	30	30	9	5	1.22	--
5(b)	30	30	9	6	0.89	--
6	31	30	10	6	1.08	--
State of Maryland Bureau of Air Quality Control						
1(a)	30	30	8	8	0.00	--
2	30	33	15	0	4.65	7.3
3	32	35	12	5	2.20	4.9
4	31	30	12	1	3.37**	7.9**
5	30	33	18	1	4.92	5.8
6(b)	30	34	10	4	1.56	--

Note: Letters shown in parentheses after the survey set numbers refer to the initial and replicate sets of surveys conducted in the same test and control areas. For each of three agencies, set b is a replicate of set a and, for one agency, set d is a replicate of set c.

[*] If the value of the normal deviate, z, equalled or exceeded 1.65, a community odor problem was said to exist.

[**] Values of the normal deviate and odor problem index were adjusted to exclude control area responses about odors from a sewer line damaged in June 1972 by hurricane Agnes.

Table 3. Number of odor complaints to participating agencies against sources suspected by agencies of causing odor problems in test areas (January 1972 through September 1972*).

Public Attitude Survey Set No.	Source(s) of Odor	No. of Odor Complaints Against Source(s): From All Persons	From Residents of Test Area
City of Houston Department of Public Health			
1	Sanitary landfill	2	2
2	Asphalt and pesticide manufacturing	3	2
3	Refineries and rubber manufacturing	88	35
4(a)	Pesticides and general chemical manufacturing	N.A.	N.A.
5	Refineries and rubber manufacturing	88	35
6(c)	Rubber manufacturing	88	32
7(b)	Pesticides and general chemical manufacturing	N.A.	N.A.
8(d)	Rubber manufacturing	88	32
Hillsborough County Environmental Protection Commission			
1	Sewage treatment plant	3	1
2	Fertilizer manufacturing	9	5
3	Barbecue restaurant	1	1
4	Citrus processing plants	N.A.	N.A.
5	Natural organic decomposition (Hillsborough Bay)	1	0
6	Asphalt manufacturing	N.A.	N.A.
7	Natural organic decomposition (Hillsborough Bay)	1	0
8	Natural organic decomposition (Hillsborough Bay)	1	0
Columbia-Willamette Air Pollution Authority			
1	Pulp mill	5	0
2(a)	Pulp mill	5	1
3	Animal rendering plant	4	0
4	Wood preserving plant	0	0
5(b)	Pulp mill	5	1
6	Pulp mill	5	1
State of Maryland Bureau of Air Quality Control**			
1(a)	Distillery	2	0
2	Sewage treatment plant	3	1
3	Asphalt manufacturing	2	2
4	Coffee manufacturing	9	0
5	Sewage treatment plant	0	0
6(b)	Distillery	2	0

Note: Letters shown in parentheses after the survey set numbers refer to the initial and replicate sets of public attitude surveys conducted in the same test and control areas. For each of three agencies, set b is a replicate of set a and, for one agency, set d is a replicate of set c.

* This was approximately the period during which the field activities were performed.

** The number of odor complaints shown for the State of Maryland include some complaints received by the Baltimore County and Prince George's County Health Departments.

Even if the agencies did not feel that it was necessary to use either of the sensory techniques described in the procedure for source verification, they were encouraged to apply them and, thereby, gain experience necessary for a comprehensive evaluation. Their application is illustrated in the following examples.

In Houston, all but one of the test areas were established near a vast complex of oil refineries and chemical manufacturing plants situated along the Houston Ship Channel. One of the typical test areas and the surrounding plants is shown in Figure 3. At different times and wind directions, the test areas received odorous emissions from different plants. The annoyance among the residents seemed to be caused by a virtual continuum of these emissions from the complex as a whole. In most cases, however, a particular odor was encountered most often. These odors were made the object of the source investigations.

Intensities in excess of 170 dilutions to threshold were measured on occasions at various locations, and many readings greater than 7 dilutions to threshold were obtained a high proportion of the time in the test areas. Despite the abundance of odors, however, a pattern of peak odor intensities could not be constructed with sufficient precision to pinpoint the offending plants.

Source verification was therefore attempted by use of an odor judgment panel. The application of this technique was complicated because of the size of area affected, the difficulty in distinguishing between odors of similar quality, and the difficulty in preparing stable, non-toxic standards representative of the various odor qualities encountered. Again, odor distribution patterns could not be obtained because of these complications and a lack of budgetary allowances to find solutions.

Because of the failure to pinpoint the source by the construction of odor distribution patterns, source verification was finally based on the ability of the agency's inspectors to recognize the quality of the predominant odors and to associate them with particular plants and processes. In doing so, they were sometimes faced with only subtle differences in the quality of the various odors. Evidence gathered in this way is of last resort. It depends not only on inspectors' knowledge of the characteristic odors of many processes, but also on their familiarity with the industrial operations in a given community. It is hard to document objectively and can be readily attacked as mistaken opinion.

The scentometer and an odor judgment panel were also used in Hillsborough County. Twelve people, who had successfully completed triangle tests indicating that they possessed average sensitivity to odors, were employed as panelists. They received odor intensity training with reference standards of tertiary dodecyl mercaptan. The panelists were deployed in the test area affected by emissions from the sewage treatment plant (see Hillsborough County public attitude survey set no. 1 in the above tables). The test area was small and the sewage odor was easily detectable against a background of odorless air. As shown in Figure 4,

Figure 3. Location of industrial complex and test area where City of Houston Department of Public Health conducted odor judgment panel evaluations.

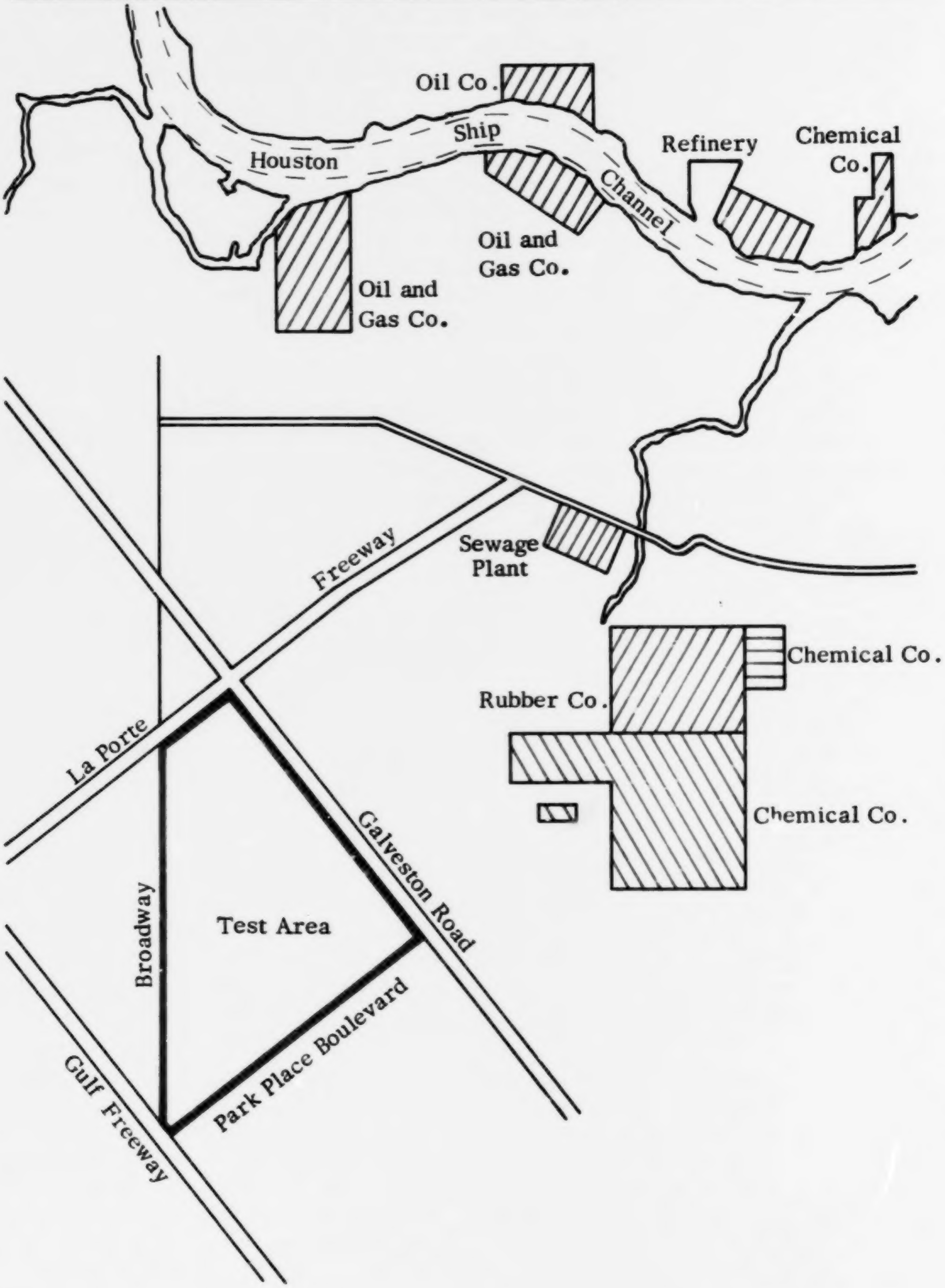
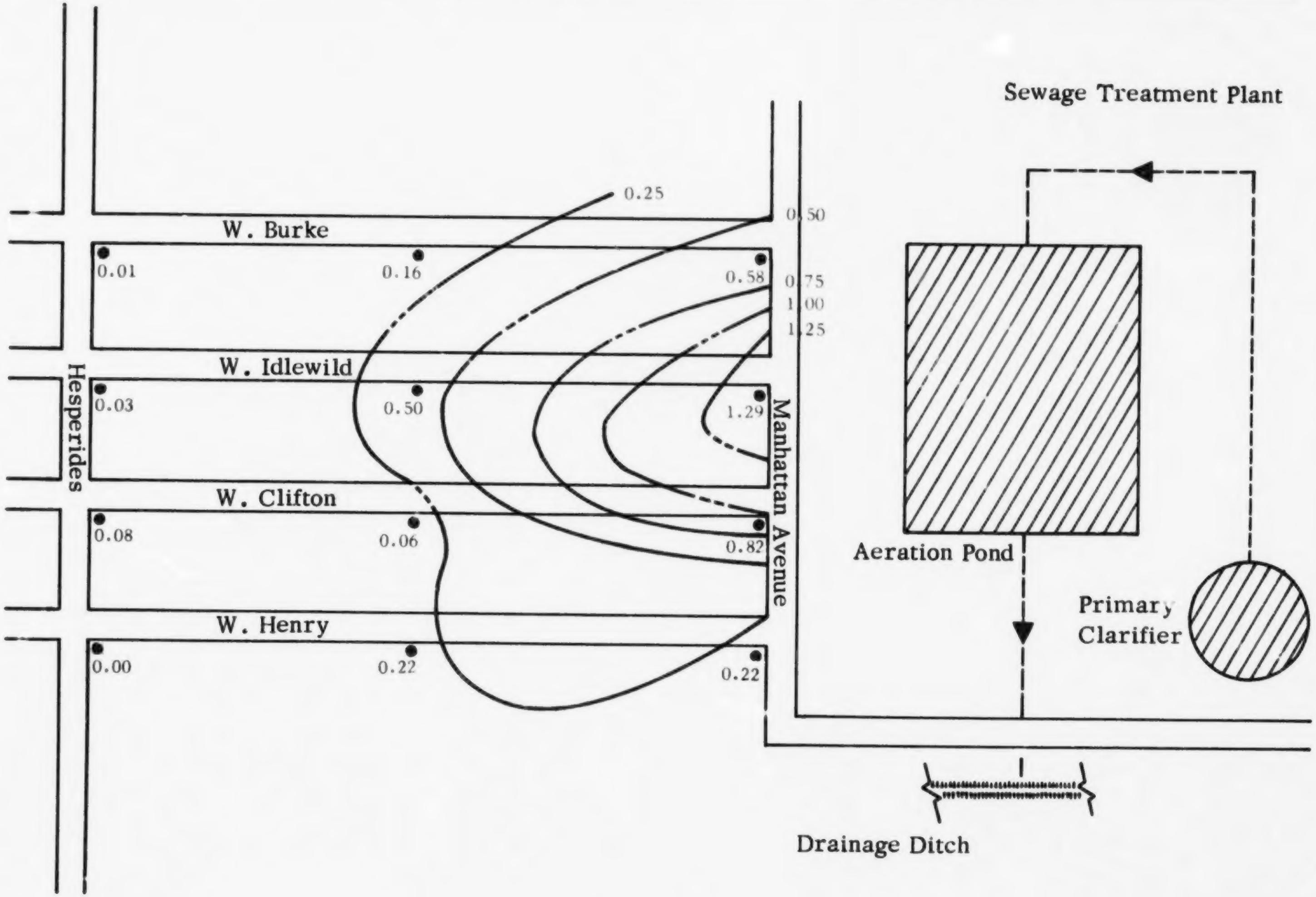


Figure 4. Mean odor intensity isopleths obtained by Hillsborough County Environmental Protection Commission by deployment of an odor judgment panel in a small test area near Tampa, Florida.



odor intensity isopleths were plotted from the scores obtained by the panelists. In this case, the isopleths clearly indicated the source of the odor.

Only the scentometer was used by the Columbia-Willamette and State of Maryland agencies. Odor judgment panel observations were not attempted.

EVALUATION OF THE PROCEDURES AND TENTATIVE MODEL ORDINANCE

A comprehensive evaluation form was prepared by Copley International Corporation to assure that the evaluation data reported by each of the four agencies were comparable. The answers to 48 open ended questions along with much supporting information were requested. A copy of the form is given in Appendix D. The technical and legal staffs of the agencies were asked to complete the form and return it to CIC during what was to become the ninth month of agency participation.

The reported data were reviewed extensively by CIC and Pope, Evans and Robbins, Inc. Omissions and ambiguous statements were discussed with the appropriate agency staff members. Similarly, unusual findings were verified for accuracy.

All recommended modifications to the procedures and tentative model ordinance were considered. Many involved simple refinements and were implemented without comment. Others, particularly as they involved the overall utility of the procedures or the structure and content of the tentative model ordinance, are presented below.

Evaluation of the Procedures

The agencies had the following comments about the design and applicability of the procedures:

- Through the direct application of the manual, "Procedures for the Identification and Assessment of Community Odor Problems," the manpower requirements for the participating personnel were optimized. Since our agency maintains a comprehensive record of odor complaints, the three conditions necessary for a "chronic situation" resulted in the direct application to the task of setting up matched test and control areas.

  The minor problems encountered in conducting the public attitude surveys were quickly resolved with verbal clarification by the Project Director. The scentometer and odor panel evaluations provided new interest and avenues of odor investigation and evaluation previously unavailable to local enforcement agencies.[1]

- The section of the manual, "Procedures for the Identification and Assessment of Community Odor Problems," dealing with public attitude surveys provided all necessary information in a comprehensible, concise manner. We consider the public attitude survey technique as described in this procedure manual too restrictive for use on most typical odor problem areas in Hillsborough County. Most odor sources in this county do not affect the required number of people for use of this method.

  We think the odor judgment panel as described in the procedure is too costly and time consuming to be useful on the small, isolated odor problems in this area. A smaller panel (4-6 persons) would be more useful for source verification in these cases.

  We found the scentometer to be a useful tool for determining odor intensity and for source verification, and it has the advantage of requiring only one person for its operation.[2]

- The procedural manual forms the foundation for Section III of the model ordinance by describing in detail the methods and techniques to be employed in the selection of test and control areas, the process of sample selection within the selected areas, the techniques used in the public attitude survey and the interpretation of the survey results. With a few minor exceptions, we have found the procedural manual to be clear and concise, especially in the areas of interpreting the survey results and in the survey techniques themselves.

  Although we feel that the results of the surveys do accurately represent the attitude of the areas surveyed, we do not feel that the results necessarily reflect the opinion of residents living immediately adjacent to the odor source. The reason for the disagreement between our opinion and the finding of the attitude survey undoubtedly lies in the large area of the census tracts over which the surveys were conducted. Application of the survey method to localized problem areas may provide a more reasonable assessment of the odor problems.

  This agency finds that the process of test area and control area selection, sample selection and public attitude surveys may be too cumbersome to use during routine odor control enforcement proceeding but may be of value under unusual circumstances where additional support to our present odor rule is required.

> All of the source verification work conducted by the Staff during the course of the program utilized the Barnebey-Cheney Model I-3 Scentometer. We found that the results obtained from using the scentometer did justify the efforts required to use them. The odor panel technique was not used during the course of the program and in our judgment would not be practical for routine field odor investigations. Application of the scentometer in a moving vehicle appears to be a very effective way to provide rapid odor source verification.[3]

- Our evaluation of the procedures...indicates (that...the) Barnebey-Cheney Scentometer, as delivered, is not suitable for odor threshold determinations (and that...the) survey technique, with minor modifications and careful application, can be a useful in-house tool for assessing the scope of a potential odor problem in urban and suburban settings.[4]

It should be clear from these comments that the agencies held different opinions about various aspects of the applicability of the procedures. However, most of the agencies agreed that there are three main shortcomings to the procedures:

(1) The procedure for problem identification cannot be applied to sparsely populated communities in which only a few homes are affected.

(2) The procedure for problem identification is not applicable to the measurement of the undesirable effects of odor on commercial or industrial groups.

(3) Some of the tasks, particularly the delineation of test and control areas and the training and deployment of an odor judgment panel, are too cumbersome for routine application.

The first point is acknowledged. It arises from the need to determine whether or not a significant difference exists between the attitudes of residents of a test area and those of a matching control area, i.e., to determine, within a known probability of error, whether or not an odor problem exists in the test area. To do so, without resorting to a complex analysis of small sample sizes, requires that residents of at least 20 (and preferably 30) homes in each area must be successfully interviewed.

The second point is not considered a shortcoming. The opinions of retail businessmen about odors in their communities were studied as part of the national survey of the odor problem. As a group, the businessmen were less concerned about odors than the residents of the same communities. Only 8 out of 138 businessmen (6%) interviewed in test areas felt that odors had a negative effect on their businesses. Of these, only 2 (less than 2%) felt that the presence of odors had reduced the annual revenue of their business by more than 10 percent. Thus, except for communities zoned entirely for commerce or industry, the procedures are applicable to the most sensitive group. Still, it is possible in atypical cases, where at least 20 separately owned businesses are affected by odors and are far removed from residences, that the public attitude survey could be directed at the owners of those businesses. Appropriate changes in the wording of the problem identification questionnaire would have to be accomplished beforehand, however. Beyond this, small commercial or industrial groups, like the residents of sparsely populated communities, could seek relief through private means.

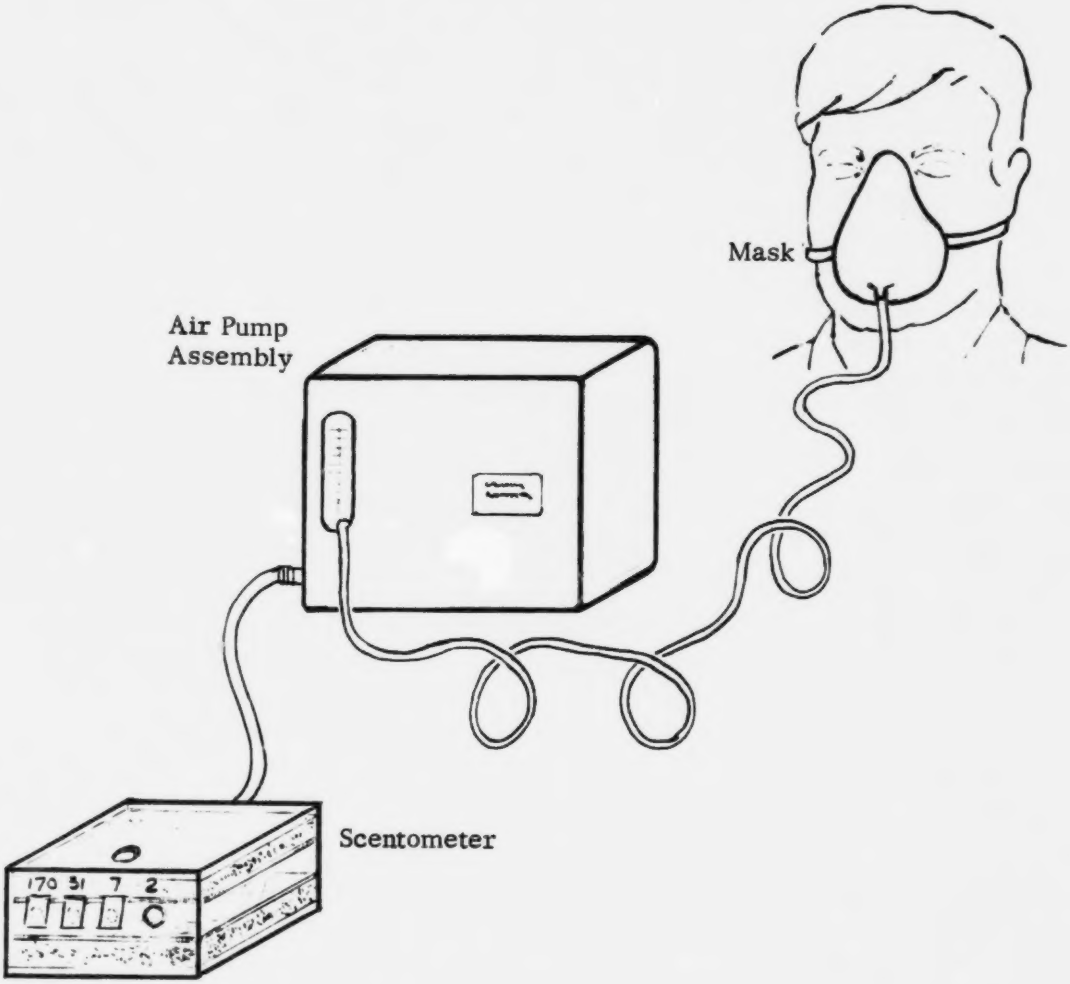
Indeed, certain tasks required in the application of the procedures are too cumbersome for purposes of routine surveillance of chronic situations. Recognizing this, three conditions were written into the procedures (and the tentative model ordinance) to limit their use (see Figure 2). In contrast to the comments itemized above, most of the agencies recommended that the limits specified by one of these conditions be reduced and that the other conditions be left unchanged. The effect of these recommendations is to liberalize, not restrict, their use. Under the limits specified, it is felt that the costs of applying the procedures as part of a criminal investigation are not excessive (estimates of the costs are included with the procedures). It seems likely that a schedule of penalties could easily be established to permit application of the procedures to be self-supporting.

The greatest variation of opinion among the agencies as expressed in the reported data concerned the use of the scentometer for purposes of both routine surveillance and source verification. Their comments are summarized in the remaining paragraphs of this section.

The City of Houston agency performed numerous measurements using the scentometer and, out of their experiences, devised a modified system with which the operator did not have to draw the air through the device by the function of his lungs. In this system, as diagramed in Figure 5, a small air pump was used to draw a fixed dilution of ambient air through the scentometer and to deliver the diluted sample under positive pressure to the operator's nose by means of a face mask. By using simple mounting devices for the pump and scentometer, one operator was able to drive an automobile safely while perceiving a selected dilution of ambient air continuously (the mobile technique is recommended in the procedure for source verification). Although designed to avoid soreness from pressure of the bulbs against the nostrils, the system has the added advantage of eliminating the need for both a driver and an operator when the measurements are taken by the mobile technique.

Although the mobile technique was used almost exclusively in Hillsborough County, the operators felt that the reading of 7 dilutions to threshold was too high

Figure 5. Modified scentometer system devised by the City of Houston Department of Public Health.



for use as an indicator of possible odor problems. The agency reported identifying odor problems by means of public attitude surveys in communities where it was unable to obtain odor intensity readings at 7 dilutions to threshold.

The Columbia-Willamette agency presently has an odor regulation based on scentometer measurements, which has been in use for several years. The exact method for using the device is not specified in the regulation, although intensity measurements have been taken routinely from a stationary position. During the field activities, agency inspectors compared scentometer measurements taken from stationary positions with those taken from an automobile. They reported successful use of the scentometer by both methods, but felt that the mobile technique was more efficient in terms of area covered by one inspector. They also reported that the scentometer bulbs were difficult to adjust to the nose for adequate breathing.

The agency reported failure to identify odor problems in communities where scentometer readings of 7 dilutions to threshold were obtained. This finding is in opposition to that obtained by the Hillsborough County agency and is thought to be due to the use of entire census tracts as test areas — a fault of the procedure for problem identification that has been corrected.

Difficulty was reported by the State of Maryland agency in using the scentometer as the operators experienced discomfort while taking measurements. When the devices were examined, it was found that the holes in the bulbs were smaller than usual and may have contributed to the discomfort. Despite this setback, the agency reported appreciation that a portable dilution device which did not "depend on the human lungs as the sample pump" would be a useful instrument.

Evaluation of the Tentative Model Ordinance

The agencies had more critical comments about the structure and content of the tentative form of the model odor control ordinance (March 1972 revision):

- We are always searching for ways to efficiently abate all air pollution sources. An effective municipal odor control ordinance is certainly the goal of this agency. The comments offered by our Legal Department adequately reflect our posture concerning the technical aspects and problems associated with the model ordinance; however, we feel that the technicalities can be resolved.[5]

- Our legal staff considers the need to random sample both the source area and a control area under the public attitude survey technique to be not necessary and possibly not relevant in a legal proceeding. They felt that the court would be primarily concerned with the effect of odors on a substantial number of aggrieved persons along with proof of the source. Because of these reasons, our Attorney did not favor the adoption of the model odor control ordinance as proposed. A modified, simpler public attitude survey procedure could be a useful tool in assessing odor problem areas, whereas surveys as described in this procedure seem more useful as a research tool.[6]

- The model ordinance may not be consistent with public nuisance law in that a public nuisance may be established by annoyance to a segment of the community whereas the model ordinance applies to a community wide problem only. Further clarification of the phrase "significantly greater" which appears in Section I of the ordinance is required to insure that the ordinance wording is clear.

  Perhaps the greatest limitation of the ordinance and the procedural manual which forms the foundation of Section III of the ordinance lies in the definition of "community odor problem." This wording restricts application of the ordinance to community residents only, precluding its use on odor problems which may occur in commercial and/or industrial areas of the community which may very well be public nuisances. Inasmuch as there is generally very little residential housing in these areas, the ordinance could not be applied. This agency would not recommend adoption of the model ordinance in place of its present rule which limits odor strengths as measured by the scentometer because of the above limitation. The ordinance may, however, be useful as a supplement to the Authority's present rule in cases where additional support is required to strengthen other odor control enforcement activities.[7]

- Our evaluation of the...proposed ordinance indicates (that...the) ordinance contains several legal problem areas which would be difficult to overcome.[8]

One or more of the agencies listed the following as the main shortcomings of the tentative model ordinance:

(1) There is a need for definitions of "community" and "significantly greater proportion of respondents." As stated, the definitions of "chronic situation" and "community odor problem" may lead to possible controversies.

(2) As a criminal law, the ordinance is not sufficiently clear to advise a person of reasonable intelligence when he would be guilty of violating the law.

(3) To the extent that the violator's guilt is determined from a survey of the past history of his performance, the crime is defined after the act and may be subject to expost facto effect.

(4) The ordinance is not consistent with nuisance law because it does not permit the protection of small portions of the population.

(5) It would have to be shown that the public attitude surveys were properly conducted.

(6) The Sixth Amendment to the United States Constitution requires that the accused be confronted by his accusers. An attempt to convict a person of a crime by use of the hearsay gathered in a survey would appear to violate this basic right.

(7) Any evidence obtained from the surveys would be useless unless each person who was bothered by odors could be shown to have been bothered by odors caused by the person being prosecuted.

(8) The need to compare areas of "similar socioeconomic characteristics" seems to give rise to discriminatory application of the law among different socioeconomic classes.

In response to the above comments, definitions of "community" and "significantly greater proportion of respondents" were added to Section I of the model ordinance, and much time was spent in considering more precise definitions of "chronic situation" and "community odor problem." Other, simpler refinements were made in Section II, the general provision, and in Section III, the procedural establishment of a violation. Beyond this, the expansion of scope of the model ordinance, e.g., to permit surveys of commercial or industrial groups, or the inclusion of additional provisions, e.g., to require notification of the polluter that he is violating, to exclude violations resulting from accident, calamity, or act of God, or to specify a cognizant enforcement authority, is left to the liking or customs of individual jurisdictions.

The identification of a community odor problem would constitute the existence of a violation under the model ordinance. Although such identification would be based on the past history of a person's performance, there is nothing to prevent the person, himself, from conducting the necessary public attitude surveys, measuring the effect of his emissions on neighboring communities, and taking appropriate action in terms of odor control before any charges are brought against him. The procedure for doing so is incorporated by reference in the model ordinance and through enactment of the model ordinance would be a matter of public record.

It is felt that the more precise definition of "community odor problem," together with the general provisions, is now sufficiently clear to advise a person of reasonable intelligence of what would be a wrongdoing. This, together with the availability of the procedure for problem identification through the public record for use by such a person in the places and at the times clearly specified by the procedure, should be sufficient to avoid ex post facto effect.

That the model ordinance is not applicable to small portions of the population, i.e., to residents of less than 20 homes, is again acknowledged. The model ordinance is consistent with public nuisance law if it can be agreed that "any considerable number of persons" must include the residents of at least 20 homes. It was not intended for the model ordinance to be applied for private means.

It would not be difficult to show that public attitude surveys were conducted properly. It is assumed that agency employees would be trained by agency supervisors before being permitted to conduct surveys that may lead to the establishment of a violation. The instructions for doing so are a part of the procedure for problem identification. The results obtained by agency employees could be readily verified by any professional survey firm as a disinterested third party. Verification is accomplished by reinterviewing the persons contacted by the agency employees and comparing the results obtained with those obtained by the agency employees.

The sixth point is acknowledged to be the main shortcoming of the proposed approach. Whenever a community odor problem is identified under the model ordinance, it may be necessary for all of the test area residents who answered affirmatively to question 9 of the Problem Identification Questionnaire — "Would you say that these odors have bothered you?" — to express their grievences directly to the court. This would be necessary if the court denied the enforcement authority from serving as the accuser, a denial which is usual in public nuisance cases. Since the identification of a community odor problem is based on group results, refusal to appear in court or change of response to question 9 on the part of any of the above mentioned test area residents may require a redetermination of whether or not a significant difference still exists between the attitude of the test area residents and those of a matching control area. Should a significant difference still exist, the case may be permitted to continue. Otherwise, the case may be dismissed due to an absence of accusers.

The difficulty of getting many test area residents to appear in court seemingly would be inversely related to the magnitude of the odor problem in their community. It may be partly or totally avoided by the use of a sequential sampling technique or by adoption of the model ordinance as a statute, rather than enactment as a form of public nuisance law. These possibilities are discussed further in the next chapter.

Inasmuch as persons who are bothered by odors cannot be expected to know the source of such odors, it is left to the expertise of the cognizant enforcement authority to determine the source. This is particularly true in cities such as Houston where numerous industrial sources are clustered together. Fortunately, it is not uncommon for the residents of a test area to suspect a given source. But, still, it is left to the expertise of the cognizant enforcement authority to verify the source. Pertinent information concerning the frequency, duration, intensity, and temporal proximity of the odors perceived by the residents of a test area and any source that they suspect can be taken from their responses to questions 4, 6, 7, 8, and 11 of the Problem Identification Questionnaire.

The eighth point raises two questions. The first is aimed at the need for a control area at all, and the second is aimed at the possibility of discriminatory application of the model ordinance. Although the use of public attitude surveys in legal proceedings, whether in a test area or a matching control area, may be unprecedented, the need for a control area should be of no surprise. It serves two purposes:

(1) Under the assumption that test area and matching control area populations both have equal right to odor free air, it provides an equitable basis for decision.

(2) Since what the population in the test area says about odors may not reflect what it actually feels about odors, it permits an estimation of true attitudes.

These purposes are discussed at length in Chapters III and VII of the final report of the second phase of research. They cannot be served by interviewing "any considerable number of persons," as might be done in the more traditional establishment of a public nuisance.

The need to match a control area to a test area by reference to the socioeconomic characteristics of the test area is only to insure that the population of the control area would be a reasonable representation of the population of the test area. As a consequence, a measurement of the attitudes of the residents of the control area as a group would be a reasonable representation of the attitudes of the residents of the test area as a group, except for any effect on the attitudes of the latter group that is due to the presence of odors in the test area. The possibility that the results of public attitude surveys may change as a function of median family income or any other socioeconomic characteristics is not only academic in this context, but also doubtful. The lack of any such relationship is also discussed further in the next chapter.

NOTES

[1] Letter from Victor N. Howard, Director, Pollution Control Division, City of Houston Department of Public Health, Houston, Texas, October 18, 1972.

[2] Letter from Roger P. Stewart, Director, Hillsborough County Environmental Protection Commission, Tampa, Florida, October 25, 1972.

[3] Letter from R. E. Hatchard, Program Director, Columbia-Willamette Air Pollution Authority, Portland, Oregon, November 10, 1972.

[4] Letter from George P. Ferreri, Acting Director, Bureau of Air Quality Control, State of Maryland Department of Health and Mental Hygiene, Baltimore, Maryland, October 17, 1972.

[5] Howard, _loc. cit_.

[6] Stewart, _loc. cit_.

[7] Hatchard, _loc. cit_.

[8] Ferreri, _loc. cit_.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

The information obtained by the four participating agencies through the applications and subsequent evaluations of the procedures for problem identification and source verification and of the tentative form of the model odor control ordinance was of great value not only in improving these documents, but also in shedding light on points of general interest in odor research. The conclusions derived from this information are presented first as they pertain to the procedures and to the model ordinance and then as they may be of general interest. A brief statement of recommendations concludes the chapter.

CONCLUSIONS PERTAINING TO THE PROCEDURES

Procedure for Problem Identification

Based on the experiences of all four agencies, it is concluded that the procedure for problem identification can be successfully applied to all possible odor problems in residential areas of at least 20 homes, regardless of the source (or sources) of the odors involved. The procedure cannot be applied to possible odor problems in residential areas of less than 20 homes, without resorting to a complex analysis of small sample sizes, or to possible odor problems in commercial or industrial areas, without even further modification. Yet, despite these limitations, it is estimated that the procedure can be successfully applied to at least 80 percent of all possible odor problems.

The tasks prescribed by the procedure were completed by the agencies with little difficulty. Their most persistent complaint was the length of time necessary to delineate a test area and a matching control area (usually one to two days) and to conduct a set of public attitude surveys (also one to two days). Based on the experiences of the Houston and Hillsborough County agencies, it is further concluded that much time can be saved by use of a professional real estate appraiser in the former task. Once shown test areas of interest to the agency, a professional appraiser with experience in the jurisdiction of the agency can often immediately suggest the location of closely matching control areas.

Time savings can also be obtained by the use of a sequential sampling technique when conducting public attitude surveys. This requires the completion of a minimum of three sets of public attitude surveys (i.e., three surveys in test areas and three in matching control areas) in accordance with the conventional survey steps outlined in the procedure. An "acceptable odor level (AOL)" and "odor problem level (OPL)" can then be calculated as described in Chapter VII of the final report of the second phase of research. Given an AOL and OPL, a sampling plan can be designed, against which the results obtained from surveys of future test areas can be compared.

The fundamental difference between sequential analysis and the conventional survey technique is that the number of interviews completed using sequential analysis is dependent upon the number of affirmative responses to question 9 of the Problem Identification Questionnaire — "Would you say that these odors have bothered you?" After each interview is completed, the results obtained are added to those already obtained during the survey and compared with "decision numbers" listed in the sampling plan. On the basis of this comparison, one of three decisions can be made:

(1) That an odor problem is identified.

(2) That an odor problem does not exist.

(3) That the results are inconclusive and that an additional interview must be completed.

The information obtained during the field activities was used by Copley International Corporation to design the sampling plans given in Tables 4, 5, 6, and 7. For each jurisdiction, an AOL was calculated from the percent of respondents in a combination of all of the control areas who said they were bothered by odors. Thus, for each of Houston and Hillsborough County, the results obtained in surveys of eight control areas were used in the design of the sample plans. For each of Oregon and Maryland, the results obtained in surveys of six control areas were used. Had these sample plans been available at the times the agencies identified their first community odor problems, the amounts of time shown in Table 8 could have been saved.

Procedure for Source Verification

During the field activities of the present study, as in the previous phases of research, odor intensity measurements were performed by dilution of the ambient air with odor free air to the odor threshold and by comparisons of the intensities of odors in the ambient air with those of reference standards. The scentometer was used for the dilution to threshold measurements, while odor judgment panels were used for the comparisons. The usefulness of these sensory techniques was evaluated in relation to three tasks:

(1) The measurement of odor intensity levels at a particular location and at a particular time.

Table 4. Sequential sampling plan based on the proportion of residents in a combination of Houston control areas who stated they were bothered by odors (AOL = 0.233, OPL = 0.433, α = 0.05, β = 0.05).

Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	31	6	14
2	*	*	32	7	14
3	*	*	33	7	15
4	*	*	34	7	15
5	*	5	35	8	15
6	*	6	36	8	15
7	*	6	37	8	16
8	*	6	38	9	16
9	*	7	39	9	16
10	0	7	40	9	17
11	0	7	41	10	17
12	0	8	42	10	17
13	1	8	43	10	18
14	1	8	44	11	18
15	1	9	45	11	18
16	2	9	46	11	19
17	2	9	47	12	19
18	2	10	48	12	19
19	3	10	49	12	20
20	3	10	50	13	20
21	3	11	51	13	20
22	4	11	52	13	21
23	4	11	53	14	21
24	4	12	54	14	21
25	5	12	55	14	22
26	5	12	56	15	22
27	5	13	57	15	22
28	5	13	58	15	23
29	6	13	59	16	23
30	6	14	60	16	23

* A no-odor-problem decision cannot be reached until 10 interviews have been completed; an odor-problem decision cannot be reached until 5 interviews have been completed.

Table 5. Sequential sampling plan based on the proportion of residents in a combination of Hillsborough County control areas who stated they were bothered by odors (AOL = 0.086, OPL = 0.247, α = 0.05, β = 0.05).

Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	31	2	8
2	*	*	32	2	8
3	*	3	33	2	8
4	*	3	34	2	8
5	*	4	35	3	8
6	*	4	36	3	8
7	*	4	37	3	9
8	*	4	38	3	9
9	*	4	39	3	9
10	*	4	40	3	9
11	*	5	41	4	9
12	*	5	42	4	9
13	*	5	43	4	10
14	*	5	44	4	10
15	*	5	45	4	10
16	0	5	46	4	10
17	0	6	47	4	10
18	0	6	48	5	10
19	0	6	49	5	10
20	0	6	50	5	11
21	0	6	51	5	11
22	1	6	52	5	11
23	1	6	53	5	11
24	1	7	54	6	11
25	1	7	55	6	12
26	1	7	56	6	12
27	1	7	57	6	12
28	1	7	58	6	12
29	2	7	59	6	12
30	2	8	60	6	12

* A no-odor-problem decision cannot be reached until 16 interviews have been completed; an odor-problem decision cannot be reached until 3 interviews have been completed.

Table 6. Sequential sampling plan based on the proportion of residents in a combination of Oregon control areas who stated they were bothered by odors (AOL = 0.167, OPL = 0.353, α = 0.05, β = 0.05).

Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	31	4	11
2	*	*	32	5	12
3	*	*	33	5	12
4	*	4	34	5	12
5	*	5	35	5	12
6	*	5	36	6	13
7	*	5	37	6	13
8	*	5	38	6	13
9	*	6	39	6	13
10	*	6	40	7	14
11	*	6	41	7	14
12	0	6	42	7	14
13	0	7	43	7	14
14	0	7	44	8	15
15	0	7	45	8	15
16	1	7	46	8	15
17	1	8	47	8	15
18	1	8	48	9	16
19	1	8	49	9	16
20	2	8	50	9	16
21	2	9	51	9	16
22	2	9	52	10	17
23	2	9	53	10	17
24	3	9	54	10	17
25	3	10	55	10	17
26	3	10	56	11	18
27	3	10	57	11	18
28	4	11	58	11	18
29	4	11	59	11	18
30	4	11	60	12	19

* A no-odor-problem decision cannot be reached until 12 interviews have been completed; an odor-problem decision cannot be reached until 4 interviews have been completed.

Table 7. Sequential sampling plan based on the proportion of residents in a combination of Maryland control areas who stated they were bothered by odors (AOL = 0.097, OPL = 0.260, α = 0.05, β = 0.05).

Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	31	2	8
2	*	*	32	2	8
3	*	3	33	3	9
4	*	4	34	3	9
5	*	4	35	3	9
6	*	4	36	3	9
7	*	4	37	3	9
8	*	4	38	3	9
9	*	4	39	4	10
10	*	5	40	4	10
11	*	5	41	4	10
12	*	5	42	4	10
13	*	5	43	4	10
14	*	5	44	4	10
15	0	6	45	5	11
16	0	6	46	5	11
17	0	6	47	5	11
18	0	6	48	5	11
19	0	6	49	5	11
20	0	6	50	5	11
21	1	7	51	6	12
22	1	7	52	6	12
23	1	7	53	6	12
24	1	7	54	6	12
25	1	7	55	6	12
26	1	7	56	6	12
27	2	8	57	7	13
28	2	8	58	7	13
29	2	8	59	7	13
30	2	8	60	7	13

* A no-odor-problem decision cannot be reached until 15 interviews have been completed; an odor-problem decision cannot be reached until 3 interviews have been completed.

Table 8. Time that could have been saved by the use of a sequential sampling technique in surveying test areas in which community odor problems were identified.

Agency	No. of Interviews Actually Completed in Test and Control Areas	No. of Interviews Necessary to Complete Under Sequential Analysis	Amount of Time That Could Have Been Saved*
City of Houston Department of Public Health (Survey Set No. 2)	102	13	4 hrs. 27 min.
Hillsborough County Environmental Protection Commission (Survey Set No. 1)	59	3	2 hrs. 48 min.
Columbia-Willamette Air Pollution Authority (Survey Set No. 2)	61	16	2 hrs. 15 min.
State of Maryland Bureau of Air Quality Control (Survey Set No. 2)	63	11	2 hrs. 36 min.

*It is assumed that an interview took an average of 2 minutes to complete and that an average of 1 minute elapsed between interviews.

(2) The documentation of odor distribution patterns throughout a test area and over a particular period of time.

(3) The location of the source of the odor in the test area by reference to the odor distribution patterns.

Based on these evaluations, it is concluded that the scentometer is suitable for the first task, but the more comprehensive coverage of an odor judgment panel is preferable for the latter tasks.

Successful application of the odor judgment panel technique can be realized when the area affected by an odor is small enough for 12 to 16 panelists to provide adequate coverage and when the odor caused by the source under investigation is of such a quality that it can be positively identified even among other odors encountered in the area. Use of this technique in Philadelphia during the first phase of research, and in Hillsborough County under the present study, took place under these ideal conditions. The results from both studies, plotted as isopleths, clearly pinpointed the locations of the sources as well as the areal extent of the odors at the times the panels were used.

The source under investigation in Los Angeles during the second phase of research was a large refinery. The odor caused by the refinery affected a very large area and was easily recognized since the refinery was well isolated from other possible sources. The difficulty with using the odor judgment panel technique there was simply the number of panelists that would have been required to cover the area in sufficient depth for odor distribution patterns to be obtained. It is estimated that an unmanageably large number of panelists — perhaps several hundred — would have been required to achieve this end.

In Philadelphia, Los Angeles, and Hillsborough County, it was possible to select for use as reference standards stable, non-toxic odorants producing odors similar in quality to those most frequently encountered in the test areas studied. After brief periods of training, the panelists had no difficulty in recognizing the odors in the field as being from the sources under investigation and, consequently, in comparing the intensities of the odors to the reference standard scales. In Houston, however, the source under investigation was part of a vast complex of oil refineries and chemical manufacturing plants. The odors caused by many of these plants were similar, although not identical, to those caused by the source under investigation. Selection of a stable, non-toxic reference standard that was representative of the source and not representative of the adjacent plants was virtually impossible.

In situations such as these, a reference standard scale can be prepared from an odorant unlike any found in the complex. For example, Dravnieks has found that odor judgment panelists can relate the intensities of odors of very different qualities to a reference standard scale prepared from 1-butanol with very little loss in accuracy.

A difficulty with using an odorant unlike those under investigation is that odor judgment panelists must be trained not only to compare the intensities of the odors they encounter in the field, but also to associate the qualities of the odors with those caused by particular sources. To accomplish this, the panelists can be trained to recognize the odors characteristic of various sources by frequent trips to such sources or by laboratory exposure to samples of odorous substances typically emitted by such sources.

To date, 17 air pollution control agencies are known to have adopted the use of dilution devices to measure the intensities of odors from known or suspected sources. None have yet adopted the use of panels for comparison of the intensities of odors in the ambient air with those of reference standards. It is concluded that, because of the costs of training and deploying at least 12 panelists, enforcement authorities feel that the odor judgment panel technique would be impractical for routine cases of source verification. However, they appreciate the usefulness of the technique in support of court action. For routine cases, they prefer to rely on the experience of their inspectors alone in locating offending plants.

CONCLUSIONS PERTAINING TO THE MODEL ORDINANCE

From the evaluations of the four agencies and from a review of the regulations summarized in Appendix A, it is concluded that a model ordinance cannot be drafted that is compatible with the legalistic approach to controlling air pollution preferred by every jurisdiction. It is further concluded that emphasis in the development of a model ordinance is best given to a conceptual framework that would promote the most efficient solutions under the existing state of knowledge. It is impractical to establish arbitrary limits merely because they are easy to enforce or to devote resources in constructing as many ancillary provisions as are felt necessary to meet all eventualities.

The recommended form of the model odor control ordinance developed under this study is included as Figure 1 in the last section of this report, "Procedures for the Identification and Assessment of Community Odor Problems." As a no-ill-effects ordinance, it prescribes the measurement of annoyance due to odors which, as discussed in Chapter II, would serve as a convenient indicator of the existence of undesirable effects and, thus, would provide a basis for deciding whether or not a violation exists. Its adoption would tend to focus technological controls on the annoyance threshold rather than the odor threshold and, thus, would promote more efficient solutions in light of the societal consideration that the added cost of control should equal the added benefit derived from that control.

An underlying dissatisfaction with the proposed approach apparent on the part of the legal staffs of the participating agencies was that the model ordinance is intended to be consistent with public nuisance law. No doubt this attitude was partly due to their reflection on many unsatisfactory attempts to control the activities of financially or politically powerful entities by use of public nuisance law and of the greater success attained under statutes limiting such activities. Public nuisance law was followed for two reasons:

(1) In the absence of relationships between the evaluation of odor and earlier stages of odor development (see Chapter II, Figure 1), only the public's evaluation can be used to decide whether or not an odor problem actually exists.

(2) Virtually all jurisdictions are presently equipped to handle odor cases under public nuisance law, whereas relatively few have adopted statutes to handle such cases.

The main shortcoming of the nuisance approach is that all of the test area residents who, in response to the procedure for problem identification, state that they were bothered by odors may have to appear in court as accusers. However, the use of a sequential sampling technique as suggested in the opening section of this chapter would tend to minimize the number of people who would have to be involved.

That the model ordinance is intended to be consistent with public nuisance law should not preclude consideration of it as a statute. Under existing and proposed statutes, various limitations on odor have been established or are recommended. Procedures for the establishment of violations include the judgment of one or more inspectors, the use of dilution devices, and the presentation of diluted stack samples to a small panel of agency employees or representatives. By such procedures, decisions are dependent upon the perception of people. Under the model ordinance, decisions are dependent not only on the perception of people, but, more importantly, on their evaluations. It is concluded that, without modification, the model ordinance could serve as a statute to prohibit the emission of odorous substances into the atmosphere that would result in a community odor problem.

Adoption of the model ordinance may permit the enforcement authority to serve as the accuser. This may require the court's acceptance of the results of public attitude surveys in test areas and matching control areas as documentation of the existence of an odor problem much like scentometer readings are accepted as documentation of odor intensity levels in the community.

OTHER CONCLUSIONS

Several other conclusions were derived from a review of information obtained by the participating agencies during the field activities. The first of these casts further doubt on the usefulness of odor complaints in dealing with odor problems.

It was stated in Chapter VII of the final report of the second phase of research that the difficulty with using odor complaints lies in the probability that the complainants do not represent the feelings of the community as a whole and that persons who volunteer complaints about a particular situation may be expected to overstate their concern. A recent odor case in Sweden was given as an example of this. It is now concluded that odor complaints are not only unreliable for the above reasons, but also insensitive as an indicator of where odor problems may exist. A comparison of the odor problem index numbers of identified community odor problems (Table 2 of this report) with the number of odor complaints against sources from residents of the test areas (Table 3) supports this conclusion. For example, the Hillsborough County agency calculated an odor problem index number of 7.0 (10.0 is maximum) from one set of public attitude surveys. Yet, no odor complaints were received by this agency from residents of the test area during the entire period of the field activities. Similar examples can be seen from the information supplied by the other agencies. The conclusion is further supported by the expectations of the agencies based on their surveillance that odor problems would be identified in test areas where, in fact, they were identified and by the national survey of the odor problem which found that while:

> ...25 million residents in the United States could be expected to state that air pollution is a problem and that odors are a major element... Only one-half million residents would have requested some authority or agency to take action concerning air pollution. The number of residents that would have requested action concerning odor problems would be a small fraction of this.

While odor complaints cannot be ignored as an indicator of where odor problems may exist, the conclusion points to the importance of maintaining routine surveillance as a more sensitive indicator.

A second conclusion is in response to critics of the use of behavioral science techniques as a basis for enforcing odor control regulations. It has been widely suspected that the propensity to complain about odors is a function of family income in particular and socioeconomic status in general. It has been suggested more recently that responses to public attitude surveys may be subject to this same function. If so, the application of a law which owes decisions to the results of such surveys would be discriminatory. Comparisons of median home value — an excellent surrogate for both median family income and socioeconomic status — and the percent of respondents who were bothered by odors in test areas and control areas surveyed under the present study are presented in Figures 6 and 7. The data points do not seem to form any particular pattern. However, quality differences in housing were not accounted for between jurisdictions, and surveys in areas of very low median home values (below $7,750) were not attempted. Thus, the conclusion of this comparison must be that while the existence of such a function in connection with public attitude surveys cannot be entirely rejected, the likelihood of its existence is doubtful.

A final conclusion is derived from a comparison of the percentage of respondents who noticed odors with the percentage of respondents who were bothered by odors. The comparison given in Figure 8 is limited to test areas in which community odor problems were identified. Based on the results obtained in Los Angeles during the study of the social and economic impact of odors, a correlation as high as that achieved during the present study ($r = 0.91$) was unexpected. This comparison does not suggest that it is possible to identify odor problems simply by noticing odors. However, should further applications of the procedure for problem identification confirm the high correlation, it would be possible to simplify the public attitude survey requirements of the procedure even further and, thereby, permit predictions of such problems with confidence.

RECOMMENDATIONS

The overall recommendation arising from this and the previous phases of research is that the control of odors should be accomplished in an indirect manner, if at all possible, through strict adherence to air quality standards governing the emission of measurable concentrations of odorous substances into the atmosphere. In cases where air quality standards do not exist for the particular substances involved or where available instrumental or wet-chemical methods are inadequate to measure the low concentrations involved, the control of odors should be accomplished in a manner that takes consideration of the problem dimension of odors and not the mere perception. To this end, Copley International Corporation recommends that the attached "Procedures for the Identification and Assessment of Community Odor Problems" should be employed to determine whether or not an odor problem exists and, if so, the extent of such a problem relative to other odor problems in the jurisdiction. A mechanism for the official use of the procedures in the establishment of a violation is found in the model odor control ordinance included as Figure 1 in the attached procedures.

The procedures have been developed from a comprehensive study of the national odor problem and of the social and economic impact of odors. They are aimed at the measurement of the problem dimension — annoyance — rather than at arbitrary limits of odor intensity or odor quality. Their use in connection with the model ordinance would provide the most effective legal control of odors given the existing state of knowledge and would yield long term benefits not available through alternate methods to date. For example, adoption of the procedures and

Figure 6. Comparison of median home value and percent of respondents who were bothered by odors in test areas surveyed by the participating agencies.

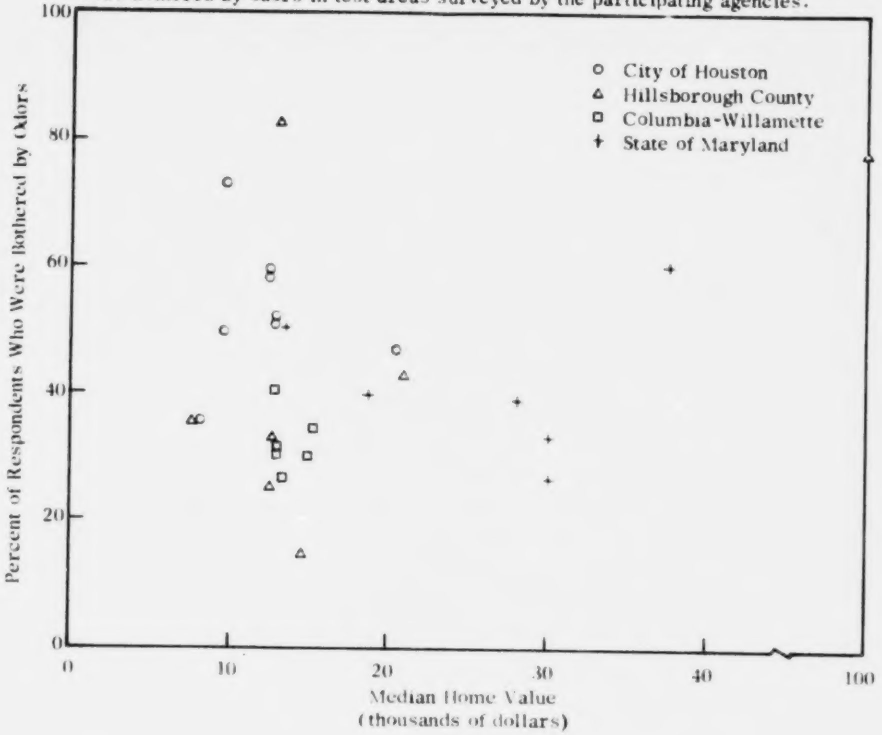


Figure 7. Comparison of median home value and percent of respondents who were bothered by odors in control areas surveyed by the participating agencies.

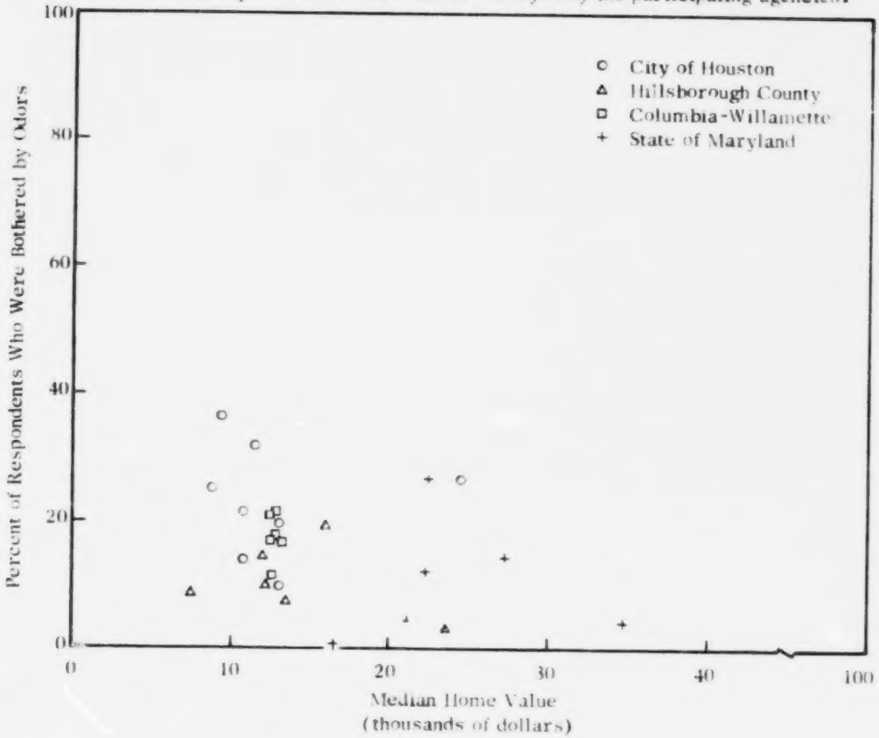
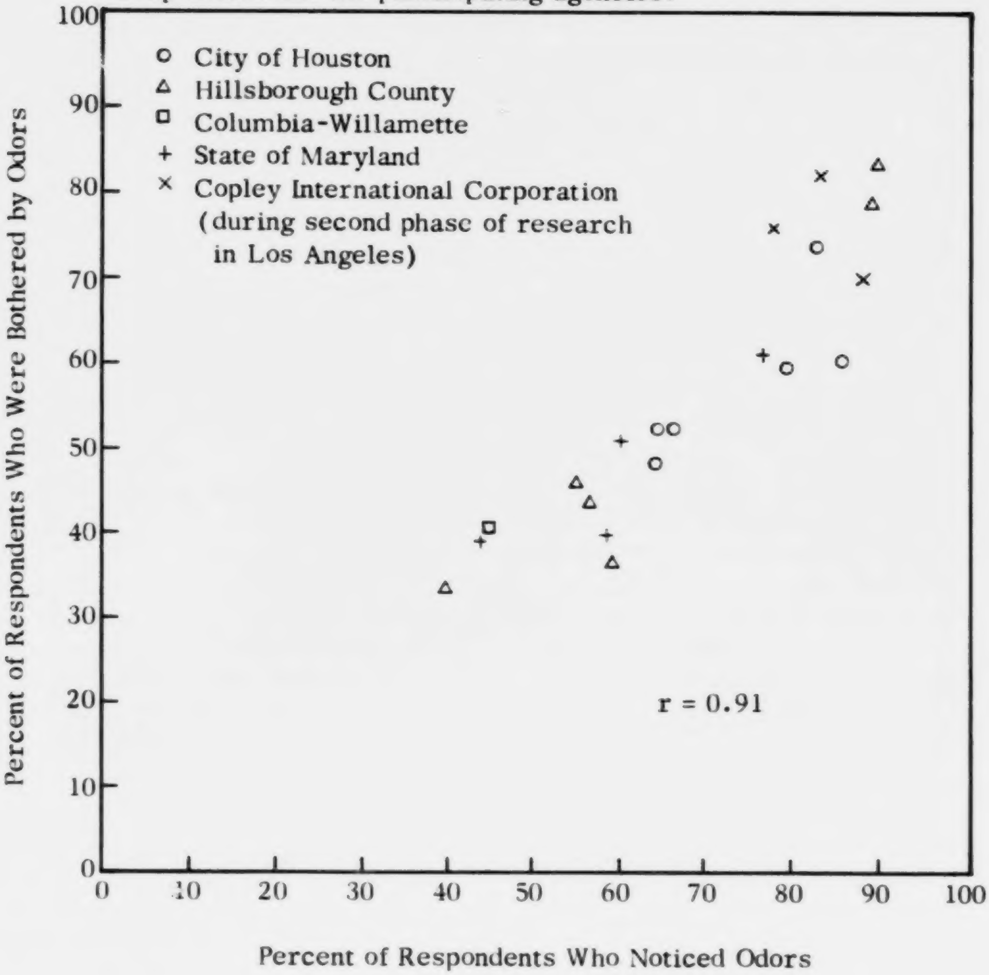


Figure 8. Comparison of the percentage of respondents who noticed odors with the percentage of respondents who were bothered by odors in test areas surveyed by Copley International Corporation and the participating agencies.



model ordinance would tend to motivate new sources to locate outside of populated areas, since violations would be based only on interference to such areas. This would be consistent with modern concepts of community planning and zoning laws which seek to separate industry from other community groups. As a further example, it is expected that, under adoption, the probability that any given chronic situation would be identified as a community odor problem would automatically increase as established sources relocate outside of populated areas or successfully apply technological controls. This is expected since such actions, particularly on the part of previous offenders, would tend both to reduce the overall intensity of background odors and to focus public attention on remaining offenders. Copley International Corporation feels that these benefits would greatly lessen the need for legislative refinements to the procedures or proposed law in order to deal with any sources or chronic situations as they may arise over time.

REFERENCES

Dravnieks, Andrew. "Odor Perception and Odorous Air Pollution," The Journal of the Technical Association of the Pulp and Paper Industry, LV, No. 5 (May, 1972), 737-742. The use of 1-butanol as an odor intensity reference standard is discussed in this and the following reference.

Dravnieks, Andrew. "Odor Suprathreshold Intensity Experiment." A report prepared by the American Society for Testing and Materials Sensory Evaluation Committee E 18. To be published.

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APPENDIX A

SUMMARY OF ODOR CONTROL REGULATIONS ENFORCED BY 203 STATE AND LOCAL AIR POLLUTION CONTROL AGENCIES

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APPENDIX A

SUMMARY OF ODOR CONTROL REGULATIONS ENFORCED BY 203 STATE AND LOCAL AIR POLLUTION CONTROL AGENCIES

In preparing the tentative form of the model odor control ordinance, it was felt that valuable guidance could be obtained from a review of as many existing and proposed odor control regulations as could be obtained from enforcement authorities throughout the nation. Specifically, it was felt that such a review would not only suggest a structure and content that would be most acceptable in all regions of the United States, but also highlight current trends in the legal controls of odors.

COLLECTION OF INFORMATION

To implement this review, it was first necessary to collect and summarize any existing and proposed odor control regulations. Thus, a letter (see below) was sent to the director of each domestic air pollution control agency listed in the Air Pollution Control Association "1970 Directory of Governmental Air Pollution Agencies." A total of 256 agencies were contacted. Of these, 203 agencies supplied information which could be summarized. A few others supplied information without any reference to themselves, to the jurisdictions in which they served, or to the jurisdictions in which the regulations were applied or proposed. Obviously, the latter information could not be summarized in the order provided below.

Unfortunately, it was not possible to determine from the information supplied by some agencies whether odors in their jurisdictions were controlled under nuisance laws or by statutes that limit the so-called "emission of odors." Since adequate information was obtained to achieve the purpose of the initial contacts with the agencies, no further contacts were attempted to distinguish between these possibilities.

USE OF INFORMATION

Use of the information provided below must be made with caution. It was collected during the Fall of 1971 and should be considered current only for that period. (Update of the information before completion of this final report was not within the scope of the present study.) Errors in interpretation and omissions of pertinent conditions, prohibitions, or control requirements may exist because of incomplete information supplied by some of the 203 agencies. No attempt was made to verify the accuracy of the information supplied.

COPLEY INTERNATIONAL CORPORATION
Economic Research • Corporate Planning • Systems Engineering • Management Services

September 28, 1971

Director
Name of Agency
Address of Agency

Subject: Request for Copy of Odor Control Ordinance

The Environmental Protection Agency has retained Copley International Corporation to conduct research into the identification and assessment of community odor problems. We are aware that state and local air pollution control agencies throughout the United States have faced such problems for years and, consequently, that some of these agencies have developed enforceable odor control standards. We appreciate that such standards reflect considerable thought and analysis on the part of agency officials, their personnel, and their legal advisors.

As part of our research for the EPA, we request that you send us a copy of any ordinance presently applicable to community odor problems in your jurisdiction. If such an ordinance does not yet exist, but has been proposed, we request that you send us a copy of the proposed law. Your cooperation would assist us in identifying standards that are common to the nation as a whole or unique to certain regions.

We have enclosed a self-addressed, stamped envelope for your convenience in transmitting the requested information to us. If an odor control ordinance does not exist in your jurisdiction, and none has been proposed, please return this letter to us in the enclosed envelope. Thank you for your attention to our request. We are looking forward to hearing from you by October 15, 1971.

Very sincerely yours,

R. David Flesh
Project Director

RDF/leh

Enclosure

Western Division Offices
7817 HERSCHEL AVENUE • P.O. BOX 1530 • LA JOLLA, CALIFORNIA 92037
TELEPHONE (714) 454-0391

LEGEND

a. Ordinance or nuisance law proposed, effective date not indicated
b. Ordinance or nuisance law proposed, approval pending
c. Ordinance or nuisance law proposed, effective beginning sometime in 1972
d. Amendment(s) to existing ordinance or nuisance law proposed, approval pending
e. Must be verified by agency (verification required within 2 hours in Independence and Kansas City, Missouri, and Clark County, Nevada)
f. 15% of 20 people exposed to it or living in the affected community
g. 25% of 20 people exposed to it or living in the affected community
h. 30% of 20 people exposed to it or living in the affected community
i. 30% of 5 people exposed to it or living in the affected community
j. 30% of a sample of people exposed to it or living in the affected community
k. 50% of 20 people exposed to it or living in the affected community
l. 75% of sample work or reside in the affected area, 25% of sample are from general public living or working outside the affected area
m. 75% if sample is less than 20 people
n. 75% if sample is less than 20 but more than 4 people (and provided that these persons are not from the same household)
o. 75% if sample is less than 6 people
p. 3 persons if sample is less than 20 people
q. 5 persons if sample is less than 20 people
r. If objectionable in usual places of occupancy
s. In residential areas
t. On, near, or adjacent to residential, recreational, institutional, retail sales, educational, and hotel premises
u. In commercial areas
v. In industrial areas or on or adjacent to industrial premises (where 2 readings or dilutions are given, the first indicates light industry; the second, medium and/or heavy industry)
w. In all other areas not mentioned elsewhere
x. When measured at or beyond property line of source
y. However, local air pollution control agency must be notified
z. Odor not specifically mentioned, but included by definition or implication stated elsewhere

EXAMPLE

A condition necessary for violation of the odor ordinance enforced by the Colorado Department of Health, Air Pollution Control Division due to the emission of odorous air contaminants from a single source is stated below as, "If Detectable...

After dilution with odor free air:
≥ 7 vol.^{su}
≥ 15 vol.^{w}"

Expanded, this means that a violation would exist if odor is detectable after dilution with 7 or more volumes of odor free air (s) in residential areas or (u) in commercial areas, or with 15 or more volumes of odor free air (w) in all other areas.

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Alabama									
State of Alabama Department of Public Health	No								
City of Birmingham, Department of Inspection Services, Smoke Abatement Division	No								
City of Huntsville, Air Pollution Control Office	Yes. Ordinance No. 66-246, Sec. 5; Ordinance No. 69-72, Sec. 15A. 74.		Not specified by whom[x]						The emission of noxious or objectionable odors which are detectable without instruments at or beyond the property line will not be permitted in the Research Park District. It shall be unlawful for any person to permit or cause foul or offensive odors...in the maintenance or operation of incinerators.
Jefferson County Department of Health, Bureau of Environmental Health	No								
Mobile County Board of Health, Bureau of Environmental Health	No								
Alaska									
State of Alaska Department of Environmental Conservation	No[a]								
Tri-Borough Air Resources Management District	Yes. Regulation 1, Secs. 9.13 and 9.19.							Farm animals. Upset conditions or breakdown of equipment[y]	Effective control apparatus and measures shall be installed and operated to reduce odor-bearing gases or particulate matter emitted into the atmosphere to a reasonable minimum. Installation or use of any device or measures to conceal or mask an emission of an air contaminant shall be unlawful.

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Arizona State of Arizona Division of Air Pollution Control	Yes. Rules and Regulations for Air Pollution Control, Regulation 7-1-2.3.								All persons owning or responsible for any process involving the reduction of animal and or vegetable matter shall provide properly constructed facilities and install and maintain in good working order such devices as are necessary to prevent emissions of air contaminants.[z]
Maricopa County Health Department, Bureau of Air Pollution Control	Yes. Rules and Regulations, Rule 32.								No person shall emit gaseous or odorous materials from equipment, operations or premises under his control in such quantities or concentrations as to cause air pollution. No person shall operate or use any machine, equipment or other contrivance for the treatment or processing of animal or vegetable matter, separately or in combination, unless all gases, vapors and gas-entrained effluents from such operation, equipment or contrivance have been: (1) Incinerated to destruction at ≥ 1300° F or processed in a manner determined to be equally or more effective for the control of air pollution; (2) All persons owning or responsible for any process involving the reduction of animal and/or vegetable matter shall install, use, and maintain such devices as are necessary to prevent or control emissions of air contaminants.
Arkansas State of Arkansas Department of Pollution Control in Ecology	Yes. Air Code, Secs. 10 and 13.							Upset conditions, breakdown or sched. maint. of equipment[y]	No person shall cause or permit the emission of air contaminants, including odors...if the emission of the air contaminant constitutes air pollution.
California State of California Air Resources Board	Yes. Health and Safety Code, Sec. 39077.							Agricultural operations and associated odors.	No person shall discharge from any nonvehicular source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.[z]
Bay Area Air Pollution Control District	No[a]								

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Calaveras County Air Pollution Control District	Yes. Regulation IV, Rule 4.5.							Odors from agricultural operations in the growing of crops or raising of fowls or animals.	A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, response, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.
Colusa County Air Pollution Control District	No								
Fresno County Public Health Department	No								
Humboldt County Air Pollution Control District	Yes. Rules and Regulations, Rules 51 and 59.							Upset conditions or breakdown of equipment.[y]	A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.[z]
Inyo County Air Pollution Control District	No								
Kern County Air Pollution Control District	No								

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Kings County Air Pollution Control District	Yes								Public nuisance law is applied to control odors.
Los Angeles County Air Pollution Control District	Yes. Rules and Regulations, Rule 51.								A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.[z]
Madera County Air Pollution Control District	No								
Mariposa County Air Pollution Control District	No								
Merced County Department of Public Health	Yes								Nuisance standard is applied to control odors.
Monterey-Santa Cruz County Unified Air Pollution Control District	No								

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Nevada County Air Pollution Control District	No								
Orange County Air Pollution Control District	Yes. Rules and Regulations, Rules 51 and 64							Odors from agricultural operations in the growing of crops or raising of fowls or animals. Equipment used exclusively for the processing of food for human consumption.	A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property. A person shall not operate or use any article, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors and gas-entrained effluents from such an article, machine, equipment, or other contrivances are: (a) incinerated at temperatures $\geq 1200^{\circ}F$ for ≥ 0.3 second, or(b) processed in a manner determined by the Air Pollution Control Officer to be equally, or more effective for the purpose of air pollution control than (a) above.[z]
Placer County Air Pollution Control District	No								
Plumas County Health Department	No								
Riverside County Air Pollution Control District	No								

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Sacramento County Air Pollution Control District	No. Agency applies State of California Health & Safety Code, Sec. 24243, as stated in Prohibition(s) column.								A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.[z]
San Benito County Air Pollution Control Board	No								
San Bernardino County Air Pollution Control District	No. Agency applies State of California Health & Safety Code, Sec. 24243, as stated in Prohibition(s) column.								A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.[z]
San Diego County Air Pollution Control District	Yes. Rules and Regulations, Rules 51 and 64.							Odors from agricultural operations in the growing of crops or raising of fowls or animals. Equipment used exclusively for the processing of food for human consumption.	A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property. A person shall not operate or use any article, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors and gas-entrained effluents from such an article, machine, equipment, or other contrivances are: (a) incinerated at temperatures ≥ 1200°F for ≥ 0.3 second, or (b) processed in a manner determined by the Air Pollution Control Officer to be equally, or more effective for the purpose of air pollution control than (a) above.[z]

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
San Luis Obispo County Air Pollution Control District	No								
Stanislaus County Air Pollution Control District	No								
Sutter County Air Pollution Control District	Yes. Rules and Regulations, Rule 4.4.							Odors from agricultural operations in the growing of crops or raising of fowls or animals.	A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.
Tulare County Air Pollution Control District	Yes. Rules and Regulations, Sec. 304.							Odors from agricultural operations in the growing of crops or raising of fowls or animals.	A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.
Colorado Colorado Department of Health, Air Pollution Control Division	Yes. Regulation 2.			Scentometer may be used	After dilution with odor free air: $\geq$7 vol.[su] $\geq$15 vol.[w]	2 meas. within one hour, at least 15 minutes apart[x]		Mfg. or agr. source using best practical control, unless odor detected after dilution with $\geq$127 vol. o.f.a.	No person, wherever located, shall cause or allow the emission of odorous air contaminants from any single source such as to result in detectable odors which are measured in excess of established limits (see other columns).
Tri-County District Health Department	No. This agency applies State odor ordinance.								

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Boulder City-County Health Department	No. This agency applies State odor ordinance.								
City and County of Denver Air Pollution Control Section	No. This agency applies State odor ordinance.								
El Paso City-County Health Department	No. This agency applies State odor ordinance.								
Jefferson County Health Department	No. This agency applies State odor ordinance.								
Mesa County Department of Public Health	No. This agency applies State odor ordinance.								
Weld County Health Department	No. This agency applies State odor ordinance.								

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		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Connecticut State of Connecticut Department of Environmental Protection, Air Pollution Control Section	Yes. Statutes and Regulations Concerning Clean Air, Secs.19-13-G29 and 19-13-G16.								No person shall cause, suffer or allow to be emitted into the open air such quantity of odorous matter in such place or manner as to have the effect, beyond his own property line, of being detrimental to members of the public or of interfering with the appetite, sleep or other environmental health factors of such members. No person shall construct, install, use or cause to be used any incinerator which will result in odors that are either annoying or harmful to health in any area of normal human use or occupancy.
City of Bridgeport Department of Air Pollution Control	Yes. Air Pollution Control Ordinances, Secs. 19-13-G29, 19-13-G15, and 44-14.								No person shall cause suffer or allow to be emitted into the open air such quantity of odorous matter in such place or manner as to have the effect, beyond his own property line, of being detrimental to members of the public or of interfering with the appetite, sleep or other environmental health factors of such members. No person shall construct, install, use or cause to be used any incinerator which will result in odors that are either annoying or harmful to health in any area of normal human use or occupancy. No person shall construct, install, use or cause to be used any equipment or process which will result in odors that are either annoying or harmful to health in any area of normal human use or occupancy.
Fairfield Health Department	No								
Greenwich Health Department	Yes. Sanitary Code, Sec. 16.3.5.		By persons[illegible]						No person shall cause, suffer, allow or permit release of one or more air pollutants of such quantities and such characteristics and duration as to create objectionable odors on or near to residential, recreational, retail sales, hotel or educational premises.

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
City of Meriden Department of Health	No[a]								No person shall cause, suffer or allow to be emitted into the open air such quantity of odorous matter in such place or manner as to have the effect, beyond his own property line, of being detrimental to members of the public or of interfering with the appetite, sleep or other environmental health factors of such members.
City of Milford Department of Environmental Health	No								
New Britain Health Department	No								
City of New Haven Health Department, Bureau of Environmental Health	Yes. Air Pollution Control Code, Sec. 28.							Upset conditions, breakdown, or sched. maint. of equipment.[y]	No person shall cause, suffer, allow or permit release of one or more air pollutants of such characteristics and duration as to create objectionable odor.
City of Norwalk Department of Health	Yes. City Code, Sec. 11-6(g).		By persons[jot]		Above threshold levels of chemical species as defined by the Manufacturing Chemical Association.				No person shall cause, suffer, allow or permit release of one or more air pollutants of such quantities and such characteristics and duration as to create objectionable odors on or near to residential, recreational, retail sales, hotel or educational premises.
Delaware State of Delaware Air Pollution Control Division	No								

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District of Columbia District of Columbia Air Pollution Division	Yes. Air Quality Control Regulations, Sec. 8-2:715.		By the Director	No. 2 odor strength		2 measurements within one hour, at least 15 minutes apart			No person shall cause, suffer, or allow an emission into the atmosphere of odorous or other air contaminants from stationary sources in sufficient quantities and of such characteristics and duration as is, or is likely to be, injurious to the public welfare, to the health of human beings, to plant or animal life, or which interferes with the reasonable enjoyment of life and property.
Florida State of Florida Department of Pollution Control	Yes								Odor control is accomplished through State nuisance laws.
Broward County Air and Water Pollution Control Board	No								
Hillsborough County Environmental Protection Commission	Yes. Pollution Control Act, Sec. 17.				By a considerable number of persons or the public, at or beyond the property limits of the premises of the person responsible for source.				No person shall cause, let, permit, suffer or allow any emission into the atmosphere or waters of any substance which may cause injury, detriment or public nuisance to any person or the public which endangers the comfort, repose, health or safety of any person or the public, or which causes or has a natural tendency to cause injury or damage to business, vegetation or animals.[z]
Metropolitan Dade County Pollution Control Department	Yes.[d] County Code, Sec. 24-3(14). Proposed: Secs. 24-14 and 24-26.				By a considerable no. of persons or the public, at or beyond the property limits of the premises of the person responsible for source.				No person shall cause, or allow to be caused, any nuisance.[dz] Solvent vapor or odor emissions from plant sites or other sources, as measured, at the user's property line, shall not exceed the established threshold limit values for solvent vapors or odors. Threshold limit for styrene is 10 ppm.[d]
Pinellas County Health Department	No								

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		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Georgia State of Georgia Department of Public Health, Air Quality Control Branch	No								
Fulton County Health Department	Yes. Health Regulation No. 24, Secs. 16 and 9.		By the health officer and persons[gq]					Diesel engines equipped & operated to minimize objec. odors.	No person shall permit the emission of objectionable odors from any source under his control. No person shall construct a new incinerator within Fulton County unless...it has a secondary burner for use when necessary to destroy smoke and/or odors.
Hawaii State of Hawaii Division of Environmental Health, Air Sanitation Branch	No								
Idaho State of Idaho Department of Health, Air Pollution Control Section	No[a]							Accidental spills or operation upsets.	No person shall allow, suffer, cause or permit the emission of odorous gases, vapors, or mists into the atmosphere in such quantities as to cause a hazard or a nuisance. No person shall allow, suffer, cause or permit any plant engaged in the processing of animal, mineral, or vegetable matter or chemical processes utilizing animal, mineral or vegetable matter to be operated without employing suitable measures for the control of odorous emissions including wet scrubbers, incinerators, or such other services as may be approved by the Commission.
Illinois State of Illinois Environmental Protection Agency	Yes. Rules and Regulations Governing the Control of Air Pollution, Secs. 3-3.280 and 3-3.400.			Scentometer used	After dilution with odor free air: 8 vol.[t] 24 vol.[v] 16 vol.[w]	2 positive concurrent determinations by 3 trained inspectors in 1 hour, at least 15 min. apart.[x]		Equipment used exclusively for processing food for human consumption and in food service establishm'ts Upset conditions, breakdown or sched. maint. of equipment.	No person shall operate or use any device, machine, equipment, or other contrivance for the inedible rendering of animal or marine matter unless all gases, vapors and gas entrained effluents from these processes shall be controlled in such manner as to effectively abate any objectionable odor nuisance. In the event that the rendering processes of more than one company are contributing to the objectionable odor nuisance, abatement shall be deemed effective when the odor concentration from each process is not more than 120 odor units per cubic foot. Installation or use of any equipment to reduce or conceal an emission which would otherwise constitute a violation is prohibited.

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Bedford Park Air Pollution Control Department	Yes. Ordinance (no. unknown), Sec. 7.								The discharge into the outdoor atmosphere of air contaminants so as to cause air pollution is a violation of this Ordinance.[2]
East St. Louis Air Pollution Control	No								
City of Evanston Air Pollution Control Division	No								
Morton Grove Air Pollution Control Commission	Yes. Air Pollution Control Ordinance, Sec. 22.606 2(b).								Escape or emission from any source whatsoever of...noxious odor...in such quantity or in such manner as to be annoying to the community, or so as to endanger or be detrimental to the health, safety, comfort, or well-being of its inhabitants, is hereby declared to be a public nuisance and is prohibited.
Quad City Area Regional Air Pollution Control Agency	No								
Indiana Indiana State Board of Health, Division of Air Pollution Control	No								

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		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
City of East Chicago Department of Air Quality Control	Yes. Air Quality Control Ordinance, Secs. 6.14 through 6.16.							Upset conditions or breakdown of any process or equipment.[y]	It is unlawful for any person to permit or cause the emission of such quantities of air contaminants from whatever source in such place or manner as to be detrimental to any person or to the public or to endanger the health, comfort, or safety of any person or the public, or in such manner as to cause or have a tendency to cause injury or damage to property or business.[z] Installation or use of any equipment for the sole purpose of diluting or concealing an emission is prohibited.
City of Evansville Air Pollution Control Department	Yes. Air Pollution Control Ordinance, Secs. 941.515 through 941.517 and 941.506(c).							Upset conditions or breakdown of any process or equipment.[y]	No person shall permit or cause the emission of such quantities of air contaminants from whatever source in such place or manner as to be detrimental to any person or to the public or to endanger the health, comfort, or safety of any person or the public, or in such manner as to cause or have a tendency to cause injury or damage to property or business.[z] Installation or use of any equipment for the purpose of diluting or concealing the emission of air contaminants is prohibited. No incinerator shall emit or produce odorous material arising from the installation which is detectable beyond the premises on which the installation is located.
City of Hammond Department of Air Pollution Control	No								
City of Indianapolis, Environmental Control Division	Yes. Rules, Regulations, and Standards, Regulation IV.		By persons,[kl] without dilution;[s] By persons,[kl] after dilution with 5 or 20 vol. odor free air[v].						No person shall cause, suffer, allow or permit the emission of gaseous materials in such quantities to cause an "objectionable odor": in areas zoned residential; in industrial areas, as shown in another column.

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
City of Michigan City Air Pollution Control Division	Yes				M1 District (ltd. mfg.): in excess of odor threshold, measured beyond lot line; M2-M3 Districts (general mfg.): in excess of odor threshold, measured beyond M2 & M3 Districts boundary line.				
Porter County Health Department	No								
St. Joseph County Health Department, Division of Pollution Control	No								
Vigo County Health Department, Division of Air Pollution Control	Yes. Air Quality Control Ordinance, Secs. 412 and 413.		By persons[k] "not associated with the problem"						It shall constitute a nuisance for any person to permit or cause the preventable emission of such quantities of air contaminants from whatever source in such place or manner as to endanger the health or safety of any person or the public, or in such manner as to cause or have a tendency to cause injury or damage to property or business. This provision shall specifically include the incineration of garbage, rubbish, trash, or any other material which produces...noxious or offensive odors in such quantity or of such duration as to interfere with the comfortable enjoyment of life or property or the conduct of business. No person shall cause, suffer, allow or permit the emission of gaseous materials in such quantities to cause an "objectionable odor."

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Iowa Iowa State Department of Health, Environmental Engineering Service	No								
Black Hawk County Health Department	No								
Linn County Health Department (City of Cedar Rapids)	Yes. Ordinance No. 81-70, Secs. 26.11 and 26.23.		By agency, based on detection criteria	Scentometer used	After dilution with odor free air: 4 vol.[tx] 20 vol.[vx] 8 vol.[wx]				No person shall cause or permit the emission of any objectionable odorous matter into the ambient air. It shall be unlawful to install a device to conceal emissions for the purpose of circumvention of ...applicable Air Pollution Control Ordinances.
Des Moines-Polk County Health Department (continued on the next page)	Yes. Air Pollution Regulation, Secs. 5-15(3), 5-16(1), 5-5(2) B-2, 5-11, 5-12, and 5-20.			Scentometer may be used	After dilution with 7 vol. odor free air	2 separate trials within 1 hour, at least 15 minutes apart		Equipment used exclusively for the processing of food for human consumption. Any plant subject to & operating under inspection by the Meat Inspection Division of the U.S. Dept. of Agriculture.	Any act of emission of ...poisonous, noxious, toxic or offensive odors from any single source in violation or excess of the limitations established in or pursuant to this ordinance shall be deemed and is hereby declared to be a public nuisance. No person may cause, permit, or allow the emission of odorous gases or matter in such durations as to cause an objectionable odor. All incinerators shall be designed and operated so that all gases, vapors, and entrained effluents shall, while passing through the final combustion chamber, be maintained at a temperature adequate to prevent the emission of objectionable odors, provided, however, that the Health Officer shall approve any other method of odor control which is equally effective. No slaughterhouse, building or place for slaughtering of animals shall be allowed or permitted to emit odorous gases or matter... that is injurious or dangerous to the health, comfort or property of individuals or to the public.

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
(continued) Des Moines-Polk County Health Department									A person shall not operate or use any article, machine, equipment or other contrivance for the reduction of animal matter unless all non-condensable toxic or odorous gases or matter, effluents from such article, machine, equipment or other contrivance are incinerated or processed in such a manner as determined by the Health Officer to be effective for the purpose of air pollution control. Installation or use of any equipment which conceals an emission which would otherwise constitute a violation is prohibited.
Kansas Kansas State Department of Health, Division of Environmental Health	No								
Kentucky Kentucky Air Pollution Control Commission	Yes. Air Pollution Control Law, Regulation No. 9.			Scentometer used	After dilution with 7 vol. odor free air				
Air Pollution Control District of Jefferson County	Yes								Odor control has been attained through a "nuisance" regulation.
Louisiana Louisiana State Department of Health, Air Control Section, Bureau of Environmental Health	No								

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Maine State of Maine Department of Environmental Protection	No								
Maryland Maryland State Department of Health and Mental Hygiene, Bureau of Air Quality	Yes. Regulations Governing the Control of Air Pollution, Secs. 43P060401 (Area V), 43P050401 (Area IV), and 43P040406 (Area III).							Any installation engaged exclusively in the processing of food for human consumption.	No person shall cause, suffer, allow or permit any discharge of gases, vapors or odors beyond the property line of an installation in such a manner that a nuisance or air pollution is created. No person shall cause, suffer, allow or permit the use of any installation primarily engaged in the reduction of offal or vegetable oil unless all gases, vapors and gas-entrained matter from said installation are: (1) First cooled to ≤ 160°F and then (2) The non-condensable fraction is incinerated at ≥1400°F for ≥ 0.4 second. (3) Alternate methods may be used if determined by the Department to be equally or more effective for the purpose of controlling air pollution. Any person processing or incinerating gases, vapors or gas-entrained matter as required above shall install, operate and maintain in good working order and calibration, continuous recording devices for indicating temperature, or pressure or other operating conditions. Such devices shall be approved by the Department...No person shall cause, suffer allow or permit any offal or vegetable oil to be handled, transported or stored or to undertake the preparation of any offal or vegetable oil without taking reasonable precautions to prevent odors from being discharged. Such reasonable precautions...shall include...(1) Storage of all offal or vegetable oil, prior to or in the process of preparation, in properly enclosed and vented equipment or areas, together with the use of effective devices and/or methods to prevent the discharge of odors or odor bearing gases. (2) Use of covered vehicles or containers of watertight construction for the handling and transporting of offal or vegetable oil. (3) Use of hoods and fans to enclose and vent the storage, handling, preparation and conveying of any odorous materials together with effective devices and/or methods to prevent emissions of odors or odor bearing gases.
Allegany County Health Department	No. State "Regulations Governing the Control of Air Pollution," as stated in the Prohibition(s) column, are applied.								
Anne Arundel County Department of Health, Division of Environmental Health, Air Quality Control Section	No. State "Regulations Governing the Control of Air Pollution," as stated in the Prohibition(s) column, are applied.								

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor[a]	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Baltimore City Health Department, Division of Air Pollution Control	Yes. Air Pollution Control Ordinance, Sec. 7A. Also, State "Regulations Governing the Control of Air Pollution," as previously stated, are applied.								No person, firm, corporation or agency operating or using, or intending to operate or use, any equipment, process, structure or space, indoors or outdoors, static or mobile, shall allow such equipment, process, structure or space, to emit any noxious acid, gas, vapor, odor...in such manner as to be dangerous or detrimental to the health or safety of the public or to interfere unreasonably with the comfort of the public.
Baltimore County Department of Health	No[c]								No person shall cause, suffer, allow or permit the discharge into the atmosphere of gases, vapors or odors beyond the property line in such a manner that a nuisance or air pollution is created.
Frederick County Health Department, Air Quality Control	No. State "Regulations Governing the Control of Air Pollution," as previously stated, are applied.								
Montgomery County Health Department, Division of Environmental Health	Yes. Ord. No. 6-40, Sec. 71-5. Also, State "Regulations Governing the Control of Air Pollution," as previously stated, are applied.								Odor may be treated as a nuisance. Any condition or operation which results in the creation of odors of such intensity and character as to be detrimental to the health and welfare of the public or which interferes unreasonably with the comfort of the public shall be removed, stopped or so modified as to remove the odor.
Prince George's County Health Department	Yes. Air Pollution Control Ordinance, Sec. 9c, f, and g. Also, State "Regulations Governing the Control of Air Pollution," as previously stated, are applied.							Unusual conditions or malfunction of equipment.[y]	No person shall cause, suffer or allow any emissions of gases, vapors or odors beyond the property line from which such emissions occur, to be in sufficient quantities and of such characteristics and duration as is or is likely to be injurious to the public welfare, to the health of human, plant or animal life, or to property, or which interferes with the enjoyment of life and property. Installation or use of any equipment for the sole purpose of diluting or concealing an emission is prohibited.

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Massachusetts City of Boston Air Pollution Control Commission	Yes. Regulations for the Control of Atmospheric Pollution, Reg. 2. Also, State Regulations for the Control of Air Pollution, Reg. 9, as stated below, are locally enforced								No person or persons owning, leasing, or controlling the operation of any air contamination source or sources shall willfully, negligently, or through failure to provide necessary equipment or facilities or to take necessary precautions, permit the emission from said air contaminant source or sources of such quantities of air contaminants which will cause a condition of atmospheric pollution.[z]
Metropolitan Boston Air Pollution Control District	No. State "Regulations for the Control of Air Pollution," as stated in the Prohibition(s) column, are enforced locally.								No person having control of any dust or odor generating operations such as, but not limited to, land clearing, construction work, dump operation, building demolition, or agricultural operation shall permit emissions therefrom to the extent that such cause or contribute to a condition of air pollution.
Pioneer Valley Air Pollution Control District	No. State "Regulations for the Control of Air Pollution," as stated in the Prohibition(s) column, are enforced locally.								
Michigan Michigan Department of Public Health, Division of Occupational Health, Air Pollution Control Section	Yes. Rules R336.46 and R336.48.							Abnormal conditions or break-down of equipment.[y]	No person shall cause or permit the emission of an air contaminant or water vapor, including an air contaminant whose emission if not otherwise prohibited by these rules, or an air contaminant or water vapor which reacts or may react with any other air contaminant or natural air, and which causes or will cause detriment to the safety, health, welfare or comfort of any person, or which causes or will cause damage to property or business.[z]

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
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City of Flint Department of Public Works and Utilities	Yes. Ordinance No. 297, Secs. 20.3 and 20.5.								No person shall keep, place or have on or in any private house, place of business, lot or premises within the City of Flint, any dead carcass ...or other animal or vegetable matter or substance which may cause any unwholesome, obnoxious or offensive smell. Nor shall any person collect or confine any horse...or other domestic or undomesitcated animal...in pens ...or otherwise so as to create an unwholesome, unsightly, malodorous, obnoxious or offensive condition. Any cart...or other vehicle used for the purpose of conveying away swill, offal, garbage or excrement shall be perfectly tight and covered so as to prevent the contents from leaking, spilling or becoming offensive because of odor, and no such cart...or vehicle when not actually in use, shall be allowed in any street...or public place within the limits of the City of Flint.
Muskegon County Health Department, Air Pollution Control Section	Yes. Air Pollution Control Rules and Regulations, Art. IV, Secs. F and H.							Abnormal conditions and breakdown of equipment.[y]	No person shall cause or permit the emission of an air contaminant or water vapor, including an air contaminant whose emission is not otherwise prohibited by these rules, or an air contaminant or water vapor which reacts or may react with any other air contaminant or natural air, and which causes or will cause detriment to the safety, health, welfare or comfort of any person, or which causes or will cause damage to property or business.[z]
Wayne County Department of Health, Air Pollution Control Division	Yes. Air Pollution Control Regulation, Secs. 6.5, 6.6, and 6.3F.							Upset conditions or breakdown of equipment.[y]	It shall be unlawful for any person to permit or cause the emission of such quantities of air contaminants from whatever source in such place or manner as to be detrimental to any person or to the public or to endanger the health, comfort, or safety of any person or the public, or in such manner as to cause injury or damage to property or business.[z] When the odor of hydrogen sulfide is found to exist beyond the property line of the source, measurements shall be taken by the method set forth in another section and if measured levels of hydrogen sulfide are found to be in excess of 0.005 ppm by volume for a maximum period of 2 consecutive minutes, the person causing or permitting such emissions into the atmosphere shall be deemed in violation of this section.

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Minnesota Minnesota Pollution Control Agency, Division of Air Quality	Yes. Air Quality Regulation, Secs. b through f.							Agri-business. Upset conditions or breakdown of equipment.[y]	No person shall cause, permit or allow emission into the ambient air of odorous air contaminants in excess of the standards and parameters which follow: (1) Odor sources emitting from well-defined stacks ≥ 50 ft. above grade elevation and with adequate dispersion characteristics as determined by the Agency shall not emit odors in > 150 odor concentration units. (2) Odor sources of < 50 ft. elevation above grade or otherwise failing to create good dispersion conditions as determined by the Agency shall not emit > 25 odor concentration units. (3) No odor source shall have an odor emission rate > 1,000,000 odor concentration units/minute. (4) No odor source shall emit air contaminants into the ambient air which cause odor outside the alleged polluter's property line in excess of the following limitations: (a) One odor unit in areas zoned residential, recreational, institutional, retail sales, hotel or educational. (b) Two odor units in areas zoned light indus. (c) Four odor units in areas zoned other than in subsections (a) and (b) above.
St. Cloud Health Department	Yes. Ordinance No. 668, Sec. 6.								The production or maintenance of Air Pollution within the City is deemed to be a public nuisance; it shall be unlawful for any person to cause or maintain an air pollution nuisance in the City.[z]
St. Louis County Health Department	Yes							Temporary operational breakdown or cleaning of air pollution control equipment, unless an immed. public health hazard results.[y]	No person shall cause, suffer, or allow any emissions of gases, vapors, or odors beyond the property line from which such emissions occur, to be in sufficient quantities and of such characteristics and duration as is or is likely to be injurious to the public welfare, to the health of human, plant or animal life, or to property, or which interferes with the enjoyment of life and property. In the absence of appropriate control measures no person shall use products which, either by themselves or due to additives or impurities, result in air pollution.

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Mississippi Mississippi Air and Water Pollution Control Commission	Yes. Air Quality Regulations, Sec. 3.4.								No person shall cause, permit, or allow the emission of particles, or any contaminants in sufficient amounts or of such duration from any process as to be injurious to humans, animals, plants, or property, or to be a public nuisance, or create a condition of air pollution.
Missouri Missouri Air Conservation Commission	Yes. Air Quality Standards and Air Pollution Control Regulations, Regulations XV (A and B), XVI (A2, B, and C), and S-IV (D3 and F).		By persons;[hmt] By persons[hm] after dilution with odor free air: ≥ 20 vol.[v] ≥ 4 vol.[w]					Equipment used exclusively for the processing of food for human consumption in food service establishments. Incinerators on residential premises and used exclusively to dispose of refuse originating on the same premises, provided that the total no. of dwelling units on that premises does not exceed four.	No person shall emit odorous matter such as to cause an objectionable odor: (1) on or adjacent to residential, recreational, institutional, retail sales, hotel or educational premises; (2) on or adjacent to industrial or other premises, as shown in another column. No person shall operate or use any device, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors, and gas-entrained effluents from such facility are incinerated at ≥ 1200°F for ≥ 0.3 second, processed in such manner as determined by the Executive Secretary to be equally or more effective for the purpose of air pollution control. Effective devices and/or measures shall be installed and operated such that no vent, exhaust pipe, blow-off pipe or opening of any kind shall discharge into the outdoor air any odorous matter, vapors, gases, or dusts or any combination thereof which create odors or other nuisances in the neighborhood of the plant. Odor producing materials shall be stored and handled in a manner such that odors produced from such materials are confined. Accumulation of odor producing materials resulting from spillage or other escape is prohibited. Odor bearing gases, vapors, fumes, or dust arising from materials in process shall be confined at the point of origin so as to prevent liberation of odorous matter. All new incinerators shall be designed and operated so that all gases, vapors and entrained effluents shall, while passing through the final combustion chamber, be maintained at a sufficient temperature to destroy all odor, provided, however, that the Executive Secretary shall approve any other method of odor control which he determines is equally effective.

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		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Greene County-City of Springfield Air Pollution Control Authority	Yes. Air Pollution Control Standards, Secs. 2A-39, 2A-40, and 2A-47.		By persons;[hmt] By persons[hm] after dilution with odor free air: ≥ 20 vol.[v] ≥ 4 vol.[w]					Upset conditions in or breakdown of equipment[y]	No person shall emit odorous matter such as to cause an objectionable odor: (1) on or adjacent to residential, recreational, institutional, retail sales, hotel or educational premises; (2) on or adjacent to industrial or other premises, as shown in another column. Installation or use of any equipment for the sole purpose of diluting or concealing an air contaminating emission is unlawful.
Independence Health Department	Yes. Ordinance No. 1977, Secs. 11.156 and 11.163.	One[e]		No. 2 odor strength		2 measurements within one hour, at least 15 min. apart		Uncontrollable force or upset conditions[y]	No person shall cause or permit odorous emissions so as to cause a violation (see other columns for specifics).
Kansas City Health Department	Yes. Air Pollution Control Code, Secs. 18.98, 18.88, and 18.90(B2).	One,[e] verified at point of complaint		No. 2 odor strength		2 measurements within one hour, at least 15 min. apart		Uncontrollable force or upset conditions[y]	The emission into the ambient air of air contaminants resulting in air pollution, in violation of any section under this article, is declared to be and shall constitute a public nuisance, and it shall be unlawful for any person to cause, permit or maintain any such public nuisance. No person shall cause or permit odorous emissions so as to cause air pollution. All incinerators shall be designed and operated so that all gases, vapors and entrained effluents shall, while passing through the final combustion chamber, be maintained at a temperature adequate to prevent the emission of objectionable odors. Provided however, that the director shall approve any other method of odor control which he determines is equally effective.
City of St. Louis Division of Air Pollution Control (continued on the next page)	Yes. Air Pollution Ordinance 54699, Secs. 22, 23, and 38 and Ordinance 50163, Sec. 15.							Upset conditions, breakdown or scheduled maintenance.[y]	No person shall cause or permit the emission of odorous matter so as to cause an odor amounting to air pollution: (1) on or adjacent to premises situated in residential, local business, or central business districts; (2) on or adjacent to premises located in industrial or unrestricted districts, when diluted with 20 vol. of odor free air; (3) on or adjacent to premises located in the commercial districts, when diluted with 4 vol. of odor free air. The emission or escape into the open air within the city...from any source or sources whatsoever, of...odors...in such manner or in such amounts as are detrimental to or endanger the health, comfort, safety or welfare of or cause

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(continued) City of St. Louis Division of Air Pollution Control									severe annoyance or discomfort to, or is offensive and objectionable to the public, or shall cause injury or damage to property or interfere with the normal conduct of business, is hereby declared to be and shall constitute a public nuisance...It shall be unlawful for any person to cause, permit or maintain any such public nuisance. No person shall operate or use any device, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors, and gas-entrained effluents from such facility are incinerated at ≥1200°F for ≥ 0.3 second, or processed in such a manner as determined by the Commissioner to be equally or more effective for the purpose of air pollution control. Effective devices and/or measures shall be installed and operated such that no vent, exhaust pipe, blow-off pipe or opening of any kind shall discharge into the outdoor air any odorous matter, vapors, gases, or dusts or any combination thereof which create odors or other nuisances in the neighborhood of the plant. Odor producing materials shall be stored and handled in a manner such that odors produced from such materials are confined. Accumulation of odor producing materials resulting from spillage or other escape is prohibited. Odor bearing gases, vapors, fumes, or dust arising from materials in process shall be confined at the point of origin so as to prevent liberation of odorous matter.
St. Louis County Health Department Division of Air Pollution Control	Yes. Air Pollution Control Code, Regulations XV and XVI.		By persons:[hmt] By persons[hm] after dilution with odor free air: ≥ 20 vol.[v] ≥ 4 vol.[w]					Equipment used exclusively for the processing of food for human consumption in food service establishments.	No person shall emit odorous matter such as to cause an objectionable odor: (1) on or adjacent to residential, recreational, institutional, retail sales, hotel or educational premises; (2) on or adjacent to industrial or other premises, as shown in another column. Control requirements and prohibitions regarding the reduction of animal matter are the same as those stated above for the City of St. Louis, except that Executive Secretary is substituted for Commissioner.

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Montana Montana State Department of Health	Yes. Regulation 90-009.							Equipment used exclusively for the processing of food for human consumption in food service establishments.	No person shall cause, suffer, or allow any emissions of gases, vapors, or odors beyond the property line in such manner as to create a public nuisance. A person operating or using any machine, device, equipment, or other contrivance which discharges into the outdoor air any odorous matter or vapors, gases, dusts, or any combination thereof which create odors, shall provide, properly install, and maintain in good working order and in operation such devices as may be specified by the Director. Odor producing materials shall be so stored and handled that odors produced thereby do not create a public nuisance. No person shall accumulate such quantities of such materials as to permit spillage or other escape. Odor bearing gases, vapors, fumes, or dusts arising from materials in process shall be so confined at the point of origin as to prevent liberation of odorous matter. No person shall operate or use any device, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors, and gas-entrained effluents from such facility are incinerated at $\geq 1200^{o}F$ for ≥ 0.3 second, or processed in such manner as determined by the Director to be equally or more effective for the purpose of air pollution control. A person incinerating or processing gases, vapors or gas-entrained effluents pursuant to this rule shall provide, properly install and maintain, in good working order and in operation, devices as specified by the Director for indicating temperature, pressure, or other operating conditions.
Billings-Laurel-Yellowstone County Air Pollution Control Program	Yes. Regulation No. 009. Agency's regulations are identical with those of the State.								
Cascade County Air Pollution Control Program	Yes. Regulations, Sec. XVI. Agency's regulations are identical with those of the State.								
Missoula City-County Health Department	Yes. Agency's regulations are identical with those of the State.							Same as above.	The following prohibition is in addition to the control regulations stated above. Installation or use of any device which conceals or dilutes an emission of air contaminant which would otherwise violate an air pollution control regulation is prohibited.

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Nevada State of Nevada Bureau of Environmental Health	Yes. Air Pollution Control Regulation XVII.				After dilution with $\geq$ 8 vol. of odor free air	2 meas. within 1 hour, at least 15 minutes apart		Upset, breakdown or sched. maint.[y]	It is unlawful for any person to discharge, or cause to be discharged from any source whatsoever any material or air contaminant of any kind or description, which is or tends to be, offensive to the senses or injurious or detrimental to health and safety, or which in any way unduly interferes with or prevents the comfortable enjoyment of life or property by any considerable number of persons or the general public.[z]
Clark County District Health Department, Air Pollution Control Section	Yes. Air Pollution Control Regulations, Secs. 20 and 12.	One[e]			After dilution with $\geq$ 2 vol. of odor free air	2 meas. within 1 hour, at least 15 min. apart		Upset, breakdown or sched. maint.[y]	
Washoe County District Health Department	No.[a] Proposed: Air Pollution Control Regulations, Secs. 040.050 and 020.085.				After dilution with $\geq$ 8 vol. of odor free air	2 meas. within 1 hour, at least 15 minutes apart		Upset, breakdown or sched. maint.[y]	It is unlawful for any person to discharge, or cause to be discharged, from any source whatsoever, any quantity of odorous or gaseous emissions, materials, or air contaminants of any kind or description, which is, or tends to be offensive to the senses, or injurious or detrimental to repose, health, and safety, or which in any way unduly interferes with or prevents the comfortable enjoyment of life or property by any considerable number of persons or the general public.
New Hampshire New Hampshire Air Pollution Control Agency	No.[a] Proposed: Regulation No. 16.		By an independent panel,[u] when diluted with odor free air: 2 vol. in light indus. areas; 4 vol.[w]	Scentometer may be used				Malfunction or breakdown, up to 48 hours[y]. Odors resulting from the normal production and cultural practices of agric.	No person shall cause, suffer, allow or permit the discharge of materials into the ambient air which cause or contribute to an objectionable or obnoxious odor at any location occupied by the public as follows: (1) in areas zoned residential, recreational, institutional, retail sales, hotel or educational; (2) in areas zoned light industrial and in areas other than those already described (see other columns for specifics).
New Jersey New Jersey State Bureau of Air Pollution Control, Division of Environmental Quality, Department of Environmental Protection	Yes. Air Pollution Control Code, Sec. 3.4.								No person shall construct, install, use or cause to be used any common incinerator or any special incinerator which will result in odors being detectable by sense of smell in any area of human use or occupancy.

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City of Elizabeth Department of Health, Welfare and Housing, Division of Housing and Inspections	Yes. Sanitary Code, Secs. 38-247 and 38-284 (B6).								No person shall create, commit, maintain or permit to be created, committed or maintained any nuisance.[z] No person shall cause, suffer, permit or allow any odorous matter, vapor, gases, particulates or any combination thereof to cause air pollution
Suburban Air Pollution Commission (West Orange)	Yes. Air Pollution Code, Sec. 8:13.								No person shall construct, install, use or cause to be used any common incinerator or any special incinerator which will result in odors being detectable by sense of smell in any area of human use or occupancy.
New Mexico State of New Mexico, Environmental Improvement Agency	Yes								Odor problems handled on a nuisance basis.
City of Albuquerque Department of Environmental Health	Yes. Animal Control Ordinance, Sec. 39.								Any animal or animals that habitually or continuously bark, howl or otherwise disturb the peace and quiet of the inhabitants of the City of Albuquerque or are kept or maintained in such a manner or in such numbers as to disturb by noxious or offensive odors or otherwise endanger the health and welfare of the inhabitants of the City of Albuquerque are declared to be an animal nuisance. It shall be unlawful for any person to keep, harbor or maintain an animal nuisance as defined above within the City of Albuquerque.
New York New York State Department of Environmental Conservation	Yes. Rules to Prevent Air Pollution, Secs. 186.1 and 187.3; Ambient Air Quality Standards, Table II.								No person shall permit or cause any air contamination source to produce air pollution.[z] No person shall cause, permit or allow the emission of air contaminants from an emission source resulting from an operation begun or modified, after the effective date of this Part, which exceeds the permissible emission rates specified.[z] Consistent with the economic and social well-being of the community, the ambient air shall not contain odorous substances in such concentrations or of such duration as will prevent enjoyment and use of property.

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Erie County Department of Health	Yes. Sanitary Code, Art. XIV, Rules 7.5, 1.3k and 4.4.								No person shall cause, suffer or allow air pollutants to escape to the open air in such amounts as to be a nuisance. A nuisance shall be considered to exist when air pollutants are allowed to escape to the open air in such amounts to affect the health, comfort, or property of any considerable number of persons.[z] No incinerator regardless of size, date of manufacture or date of installation shall...release to the atmosphere offensive and obnoxious odors detectable to the Commissioner or his agents at the property line.
Monroe County Department of Health	Yes. Sanitary Code, Art. V, Sec. 11.1.								No person owning, operating, in charge of or in control of any air contamination source shall cause, permit or participate in discharging into the atmosphere any air contaminant which causes air pollution.[z]
County of Nassau Department of Health, Bureau of Air Pollution Control	Yes. Local Law 1-1967, Secs. 9-21.46 and 9-21.48.								No person shall cause or permit the emission of an air contaminant which causes or may cause detriment to the health, safety, welfare or comfort of any person, or causes or may cause damage to property or business.[z] Installation or use of any device to conceal or mask an emission of an air contaminant shall be unlawful.
City of New York Department of Air Resources, Environmental Protection Administration	Yes. Air Pollution Control Code, Art. 9, Sec. 1403.2-9.01.								No person shall cause or permit the emission of air contaminant, including odorous air contaminant, or water vapor if the air contaminant, or water vapor causes or may cause detriment to the health, safety, welfare or comfort of any person, or injury to plant and animal life, or causes or may cause damage to property or business, or if it reacts or is likely to react with any other air contaminant or natural air, or is induced to react by solar energy to produce a solid, liquid or gas or any combination thereof which causes or may cause detriment to the health, safety, welfare or comfort of any person, or injury to plant and animal life, or which causes or may cause damage to property or business.

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Niagara County Health Department, Division of Environmental Health Services	No								
Onondaga County Department of Health, Division of Environmental Sanitation	No								
Rockland County Department of Health	No								
Suffolk County Department of Environmental Control	No								
North Carolina State of North Carolina Department of Water and Air Resources	Yes. Rules and Regulations Governing the Control of Air Pollution, Regulation No. 5.								No person shall cause, suffer, allow or permit any plant engaged in the processing of animal, mineral, or vegetable matter to be operated without employing suitable measures for the control of odorous emissions including wet scrubbers, incinerators, or such other devices as may be approved by the Board.
Western North Carolina Regional Air Pollution Control Agency	Yes. Rules and Regulations Governing the Control of Air Pollution, Regulation No. 5.								No person shall cause, suffer, allow or permit any plant engaged in the processing of animal, mineral, or vegetable matter to be operated without employing suitable measures for the control of odorous emissions including wet scrubbers, incinerators, or such other devices as may be approved by the . . . Board.
Unifour Air Pollution Control Program	Yes. Regulations Governing the Control of Air Pollution, Regulation No. 5.								No person shall cause, suffer, allow or permit any plant engaged in the processing of animal, mineral, or vegetable matter to be operated without employing suitable measures for the control of odorous emissions including wet scrubbers, incinerators, or such other devices as may be approved by the Board.

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County of Forsyth Air Quality Control Department	Yes. Regulation No. 7.00.								No person shall cause, suffer, allow or permit any plant engaged in the processing of animal, mineral, or vegetable matter to be operated without employing suitable measures for the control of odorous emissions including wet scrubbers, incinerators, or such other devices as may be approved by the Air Quality Control Director.
Gaston County Health Department	No. This agency applies State odor regulations.								
Ohio State of Ohio Department of Health, Air Pollution Control Board	No.[a] Proposed regulation: AP-2-07.								The emission or escape into the open air from any source or sources whatsoever, of...odors ...in such a manner or in such amounts as to endanger or tend to endanger the health, comfort, safety or welfare of the public, or is unreasonably offensive and objectionable to the public, or shall cause unreasonable injury or damage to property or interfere with the comfortable enjoyment of property or normal conduct of business, is hereby found and declared to be a public nuisance. It shall be unlawful for any person to cause, permit or maintain any such public nuisance. Installation or use of any device or any means which conceals or dilutes an emission of air contaminant which would otherwise violate any regulations of the Board is prohibited.
Akron-Barberton-Summit County Air Pollution Control Agency	Yes. Air Pollution Code, Secs. 755.12, 755.08.1(7 and 10), and 755.10 (g3).								No owner, occupant or person in charge (by himself, his agent or employee) of any fuel-burning equipment, internal combustion engine, incinerator, railroad locomotive, vehicle, premises, open fire or stack, processes or process equipment, shall cause, suffer or allow, the discharge, emission or release, into the atmosphere therefrom, or from any other source whatsoever, of any...air contaminants so as to cause a nuisance.[z] It shall be unlawful for any person to permit or cause foul or offensive odors...in the maintenance of an incinerator. Incinerators, including all associated equipment and grounds, shall be designed, operated and maintained so as to prevent the emission of odors.

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Canton City Health Department, Air Pollution Control Division	Yes. Air Pollution Rules and Regulations, Art. IV, Secs. 14, 11, and 8.		By persons;^{ehmt} By persons^{ehm} after dilution with odor free air: ≥ 20 vol.^{v} ≥ 4 vol.^{w}						No owner, occupant or person in charge by himself, his agent or employee, shall cause, suffer or allow the emission of air contaminants into the atmosphere so as to cause a nuisance as determined by the Air Pollution Control Officer. No owner, occupant or person in charge, by himself, his agent or employee, shall cause, suffer or allow the emission of odorous matter into the atmosphere such as to cause an objectional odor, as determined by the Air Pollution Control Officer: (1) on or adjacent to residential, recreational, institutional, retail sales, hotel or educational premises; (2) on or adjacent to industrial or other premises (see other columns for specifics). Installation or use of any device or any means to conceal or mask the emission of an air contaminant is prohibited.
City of Cincinnati Department of Sewers, Division of Air Pollution Control	Yes. Ordinance No. 36-1969, Secs. 2501-1.3, and 2501-3.			≥ No. 8 or equivalent dilution;^{w} ≥ No. 16 or equivalent dilution, in M3, Heavy Mfg. Districts.	If detectable at a distance >25 feet from the incinerator chimney or at a location of a citizen complaint whichever is a greater distance. If detectable after dilution with o.f.a 7 vol.^{w} 15 vol. in M3 districts.		A period or periods > 15 min. in any 8 hours.		In the operation of an incinerator, no person shall cause or permit the emission of offensive odor...i.e., any odor similar to that of burning garbage, paper, or other cellulose material (see If Detectable column for limits). No person shall emit or cause the emission of odorous substances from any source which, at any point on the surface beyond the source property line or at the location of a citizen complaint beyond the source property line, will cause the outdoor air to become odorous air (as specified in other columns). The emission of odorous substances which cause a nuisance are also prohibited.
Ironton Air Pollution Control Agency	No								
Lake County Combined General Health District	No								

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Montgomery County Combined General Health District, Department of Health	Yes. Regulation, Sec. 126.0.								No person shall cause, allow, or permit the emission of any air contaminant so as to cause air pollution.[z]
City of Portsmouth Air Pollution Control Authority	Yes. Air Pollution Code, Secs. 1377.03, 1377.04, 1373.09, and 1377.10.		By the Commissioner of Air Pollution Control or his authorized representative;[t] by the above, after dilution with odor free air: ≥ 20 vol.[v] ≥ 4 vol.[w]					Breakdown of equipment.[y]	No owner, occupant or person in charge, by himself, his agent, or employee, shall cause, suffer or allow the emission of odorous matter into the atmosphere such as to cause an objectionable odor, as determined by the Commissioner of Air Pollution Control or his duly authorized representative: (1) on or adjacent to residential, recreational, institutional, retail sales, hotel or educational premises; (2) on or adjacent to industrial or other premises (see other column for specifics). No person shall operate or cause to be operated a rendering plant unless, all vents to the atmosphere from such rendering are substantially free of any odor causing air pollution; odor producing materials are confined and handled in such a manner that odors produced within or outside the rendering plant from this source can be controlled; excessive accumulations of odor producing materials resulting from spillage or escape do not occur; all finished products, by-products, and waste materials are either odor free or so treated as to eliminate or prevent air pollution. Installation or use of any equipment for the sole purpose of diluting or concealing an emission or distorting stack test emission results is prohibited.
Steubenville Air Quality Region	Yes. Regulation, Art. VI, Secs. 2 and 3, Art. IX, Sec. 5.		By the Chief Control Officer or his representative;[t] by the above, after dilution with odor free air: ≥ 20 vol.[v] ≥ 4 vol.[w]						
City of Toledo Pollution Control Agency	Yes. Pollution Control Code, Sec. 3-60-30.								No person shall unreasonably permit the emission of any substance into the ambient air which causes an objectionable odor, so as to cause discomfort or endanger the public health or welfare, or in such a manner as to cause injury or damage to business or property; and such air pollution is hereby found and declared to be, and shall constitute a public nuisance.

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Oklahoma Oklahoma State Department of Health, Air Pollution Control Division	No.[b] Proposed Regulation No. 10.								No person shall cause, suffer, or allow any emissions of gases, vapors, or "objectionable" odors beyond the property line from which such emissions occur, to be in sufficient quantities and of such characteristics and duration as can be shown to be injurious to the public welfare, to the health of human, plant, or animal life, or to property, or which interferes with the enjoyment of life and property.
Oklahoma City-County Health Department, Air Quality Control Division	Yes. Ordinance 12,575, Chap. 10, Sec.9.10.02.								It shall be unlawful and an offense for any person, firm or corporation to permit the emission of any obnoxious, injurious or offensive odors... from any premises, machinery, smokestacks, boilers, chimneys, owned, operated, occupied, controlled or leased by such person, firm or corporation, or any such odors...which by reason of the nature thereof, annoy any person or persons, or interfere with the peaceable enjoyment of the home, residence or premises of any person or persons, or are a menace to the public peace, health or safety.
Tulsa City-County Health Department	Yes								The general nuisance section of the Public Health Code can be applied to odors.
Oregon State of Oregon Department of Environmental Quality (continued on the next page)	Yes. Administrative Rules Compilation, Secs. 25-055 and 25-325(3).							Equipment used exclusively for the processing of food for human consumption.	A person shall not operate or use any article, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors and gas-entrained effluents from such an article, machine, equipment or other contrivance are: (1) incinerated at ≥ 1200°F for ≥ 0.3 second, or (2) processed in such a manner determined by the Sanitary Authority to be equally, or more, effective for the purpose of air pollution control than (1) above. A person incinerating or processing gases, vapors or gas-entrained effluents pursuant to this rule shall provide, properly install and maintain in calibration, in good working order and in operation, devices as specified by the Sanitary Authority, for indicating temperature, pressure or other operating conditions.[z]

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		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
(continued) State of Oregon Department of Environmental Quality									No person shall operate any hardboard tempering oven unless all gases and vapors emitted from said oven are treated in a fume incinerator capable of raising the temperature of said gases and vapors to $\geq 1500^{\circ}$F for ≥ 0.3 second. Specific operating temperatures lower than 1500°F may be approved by the Department upon application, provided that information is supplied to show that operation at said temperatures provide sufficient treatment to prevent odors from being perceived on property not under the ownership of the person operating the hardboard plant.
Columbia-Willamette Air Pollution Authority	Yes. Ambient Air Standards, Secs. 8.4, 6.2(2), 6.5, and 6.8.			$\geq$ No. 0 or equivalent dilution (>1 to <2 d/t);[s,u] $\geq$ No. 2 or equivalent dilution (>8 to <32 d/t).[w]		2 meas. within 1 hour, at least 15 min. apart taken off the property surrounding the source		Manufacturing process, if highest and best practicable treatment and control currently available is used to maintain lowest possible emission of odorous gases. Outdoor fires (a) for agric burning; (b) for recreational purposes or cooking food for human consumption; (c) those set or permitted by any public officials for fire prevention or fire control training.	No person shall cause or permit the emission of odorous matter in such manner as to contribute to a condition of air pollution, or exceed the limits shown in other columns. No open outdoor fire shall be allowed within the territory which contains garbage, asphalt, waste petroleum products, paint, paint coated metals, wire, rubber products, plastics or any substance which normally emits dense smoke, noxious odors or creates a public nuisance. Control apparatus and equipment shall be installed and operated to reduce to a minimum odor-bearing gases or odor-bearing particulate matter emitted into the atmosphere. Gas effluents from animal matter reduction or incineration shall be maintained at a temperature of 1200°F for ≥ 0.3 second, or controlled in another manner determined by the Program Director to be equally or more effective. The Authority may require that buildings or equipment be closed and ventilated so that all air, gases and particulate matter are effectively treated for removal or destruction of odorous matter. Installation or use of any device or means to conceal or mask an emission of air contaminants which would otherwise violate these Rules is prohibited.

Name of Agency (by State)	Odor Ordinance or Nuisance Law Governing Odor?	Condition(s) Necessary for Violation of Odor Ordinance or Nuisance Law						Exceptions	Prohibition(s) and Control Requirement(s) Specified in Odor Ordinance or Nuisance Law
		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Lane County Regional Air Pollution Authority	Yes. Ambient Air Standards, Sec. 2-7.3.			≥No. 0 or equivalent dilution in industrial park areas and other areas;[su] ≥No. 2 or equivalent dilution[v]		2 measurements within one hour, at least 15 min. apart			No person shall cause or permit the emission of odorous matter in such manner as to cause a public nuisance or contribute to a condition of air pollution or that occurs in areas used for residential, commercial, industrial park, or other industrial areas, as specified in other columns.
Mid-Willamette Valley Air Pollution Authority	Yes. Ambient Air Standards, Secs. 14-020, 16-140, and 16-130.			≥ No. 0 or equivalent dilution[t]; ≥ No. 2 or equivalent dilution[w]		2 measurements made within one hour, at least 15 min. apart, off the property surrounding the emission point.			No person shall cause or permit the emission of odorous matter in such manner as to cause a public nuisance or that occurs in areas used for residential, recreational, educational, institutional, hotel, retail sales or other similar purposes and in all other land use areas, as specified in other columns. Control apparatus and equipment shall be installed and operated to reduce to a minimum odor bearing gases or odor bearing particulate matter emitted into the atmosphere. Gas effluent from animal matter reduction or incineration shall be maintained at a temperature of 1200°F for ≥ 0.3 second, or controlled in another manner determined by the Director to be equally or more effective. The Authority may require that building or equipment be closed and ventilated so that all air, gases, and particulate matter are effectively treated for removal or destruction of odorous matter. Installation or use of any device or means to conceal or mask an emission of air contaminants which would otherwise violate these rules is prohibited.
Pennsylvania Commonwealth of Pennsylvania, Department of Environmental Resources, Bureau of Air Quality and Noise Control	No								Odor problems are handled under the provisions of the Air Pollution Control Act.

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Allegheny County Health Department, Bureau of Air Pollution Control	Yes. Rules and Regulations, Secs. 1713 and 1710.								No person shall cause, suffer, or allow...air contaminants...to escape to the open air in such amounts as to cause annoyance or discomfort to or be offensive and objectionable to the public or shall cause injury or is a health hazard.[z] No person shall operate or use any device, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors, and gas-entrained effluents from such facility are incinerated at a temperature of 1600°F for ≥ 0.5 second, or processed in such manner as determined by the Bureau Chief to be equally or more effective for the purpose of air pollution control. Effective devices and measures shall be installed and operated in a manner such that no vent, exhaust pipe, blowoff pipe or opening of any kind shall discharge into the open air or atmosphere any odorous matter, air contaminants, dusts or any combination thereof which create odors...Odor-producing materials shall be confined and handled in a manner such that odors produced within or outside the plant from such materials are controlled. Accumulation of odor-producing materials resulting from spillage or other means is prohibited. Odor-bearing air contaminants arising from materials in process shall be confined at the point of origin so as to prevent liberation of odorous matter into the workroom.
Air Pollution Control Board of Greater York	No								
Lehigh Valley Air Pollution Control District (continued on the next page)	Yes. Ordinance No. 20, Sec. 3 (1, 2 and 6).								It shall be unlawful for any person to emit or cause, suffer or allow to be emitted or to permit the escape into the open air of any...odors ...of the quantity or character which violates any of the provisions of this ordinance. It shall be unlawful for any person to operate or maintain or cause to be operated or maintained any installation, equipment or device which by reason of its operation or maintenance will be

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(continued) Lehigh Valley Air Pollution Control District									capable of emitting...odors...unless he shall install and maintain in conjunction therewith such control equipment as will prevent the emission or escape into the open air of any such...odors...of a character and in a quantity that would violate any of the provisions of this ordinance. It shall be unlawful for any person to cause, suffer or allow to be emitted into the open air from any fuel-burning equipment, internal combustion engine, process furnace, stack, premises or open fire...odors...that are a detriment to the property of others or that are a nuisance to any person not being therein or thereupon engaged. When the Director shall declare a nuisance as above defined to exist, it shall be deemed to have been created and may be summarily abated by the Director or his duly authorized agent.
Philadelphia Department of Public Health, Air Management Services	No								A proposed form of an odor regulation is being considered.
Rhode Island Rhode Island Department of Health, Division of Air Pollution Control	Yes. Rules and Regulations for the Prevention, Control and Abatement and Limitation of Air Pollution, Regulation 7.								No person shall emit any contaminant which either alone or in connection with other emissions, by reason of their concentration and duration may be injurious to human, plant or animal life, or cause damage to property or inconvenience to property owners, or create a disagreeable or unnatural odor or obscure visibility or which in any way interferes with the enjoyment of life and property.
South Carolina South Carolina Pollution Control Authority	No								

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Charleston County Health Department, Air Pollution Control Section	Yes								Odors from incineration must be reduced to such a point as not to create an undesirable level, i.e., the presence in the outdoor atmosphere of one or more air contaminants or any combination thereof in sufficient quantity and of such duration as to be injurious to human health or welfare, or to damage plant, animal or marine life, to property or which unreasonably interferes with enjoyment of life or use of property. A public health nuisance law has also been successfully employed in abating odors.
City of Spartanburg	No								
Tennessee Tennessee Department of Public Health, Division of Air Pollution Control	No								
Chattanooga-Hamilton County Air Pollution Control Bureau	Yes. A Regulation for the Control of Air Pollution, Sec. 9, Rules 14.1 and 12.1 through 12.3, and Secs. 14-B and 14-C.		By persons[fp]					Upset conditions, breakdown or sched. maint.[y]	No person shall cause, suffer, allow or permit or fail to take reasonable steps to abate or terminate the discharge from any source whatsoever of air contaminants or other material which shall cause injury, detriment, nuisance, or annoyance of the public or which endanger the comfort, repose, health or safety of the public or which cause or have a tendency to cause injury or damage to business or property. No person shall cause, suffer, allow or permit emission such as to cause an "objectionable" odor on or adjacent to residential, recreational, institutional, retail sales, hotel or educational premises. No person shall cause, suffer, allow or permit emission such as to cause an "objectionable" odor on or adjacent to premises other than those listed above unless air containing such odorous matter is diluted with $\geq$ 4 vol. of odor-free air.

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Knox County Department of Air Pollution Control	Yes. Air Pollution Control Regulations, Secs. 22, 14, 19(c), 25(d), and 39.		By persons[hmr] after dilution with ≥ 8 vol. odor free air					Upset conditions, breakdown or sched. maint.[y]	No person shall cause, suffer, or allow any emissions of..."Objectionable" odors beyond the property line from which such emissions occur, to be in sufficient quantities and of such characteristics and duration as can be shown to be injurious to the public welfare, to the health of human, plant, or animal life, or to property, or which unreasonably interferes with the enjoyment of life and property. No person owning, leasing, or controlling the operation of any air contamination source shall willfully, negligently, or through failure to provide necessary equipment or facilities or to take necessary precautions, permit the emission from said air contamination source of such quantities of air contamination as will tend to cause a condition of air pollution.[z] Hereafter no person shall construct a new incinerator unless it has a secondary burner for use when necessary to destroy...odors. No person shall cause, suffer, allow or permit the emission from any motor vehicle operated in Knox County of objectionable odors...that tend to endanger the human health or safety or prohibit the peaceful enjoyment of life and property.
City of Memphis-Shelby County Health Department	Yes. City Code, Sec. 3-6.								No person owning, leasing, or controlling the operation of any air contamination sources shall willfully, negligently, or through failure to provide necessary equipment or facilities or to take necessary precautions, permit the emission from said air contamination source or sources of such quantities of air contaminants as will cause, by themselves or in conjunction with other air contaminants, a condition of air pollution.[z]
Metropolitan Health Department of Nashville and Davidson County (continued on the next page)	Yes. Air Pollution Control Ordinance, Sec. 4-1-10.								The emission or discharge into the atmosphere of odorous air contaminant from any source whatsoever which causes injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endangers the comfort, repose, health or safety of any such persons or the public or which causes or has a natural tendency to

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(continued) Metropolitan Health Department of Nashville and Davidson County									cause injury or damage to business or property will constitute a nuisance, and any person violating any provision of this section will, upon conviction, be subject to penalties.
Texas Texas State Department of Health, Air Pollution Control Services	No								
City of Dallas Health Department	Yes. Clean Air Ordinance, Sec. 5A-13(7); Zoning Ordinance, Secs. 10-430 through 10-435.				If odor exceeds the odor threshold (2 odor units) in heavy industrial district after dilution with an equal volume of odor free air[x] If odor exceeds the odor threshold[wx]				No use shall be operated in any zoning district of the City of Dallas in such a manner that the emission of odorous matter occurs in such quantity or volume as to produce a nuisance, source of discomfort or hazard beyond the bounding property lines of such use.
City of Fort Worth Department of Public Health	No								
Galveston County Air Control Department	No								
City of Houston Department of Public Health, Pollution Control Division	No								

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Jefferson County Environmental Control Department	No								
Laredo-Webb County Health Department	No								
City of Pasadena Health Department	No								
Utah Utah State Division of Health	No								
Vermont State of Vermont Agency of Environmental Conservation, Air Pollution Control (continued on the next page)	Yes. Health Regulations, Secs. 5-473 and 5-474.		By persons[fn] occupying or frequenting places closest to, but beyond the property line of the source of odors.					Domestic odors	No person shall operate or use any device, machine, equipment or other contrivance for the industrial processes which as determined by the Director, Division of Industrial Hygiene is an odoriferous process per se, unless all gases, vapors, and gas-entrained effluents from such facility are incinerated at a temperature of 1600°F for $\geq$0.5 second, or processed in such a manner as determined by the Director, Division of Industrial Hygiene to be equally or more effective for the purpose of air pollution control. Effective devices and measures shall be installed and operated in a manner such that no vent, exhaust pipe, blowoff pipe or opening of any kind shall discharge into the open air or atmosphere any odorous matter, air contaminants, dusts or any combination thereof which create odors or other nuisances. Odor-producing materials shall be confined and

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(continued) State of Vermont Agency of Environmental Conservation, Air Pollution Control									handled in a manner such that odors produced within or outside the plant from such materials are controlled. Accumulation of odor-producing materials resulting from spillage or other means is prohibited. Odor-bearing air contaminants arising from materials in process shall be confined at the point of origin so as to prevent liberation of odorous matter into the workroom... Installation or use of any equipment to reduce or conceal an emission which otherwise would constitute a violation of these regulations is prohibited.
Virginia Commonwealth of Virginia State Air Pollution Control Board	Yes.[d] Rules for the Control and Abatement of Air Pollution, Rules 6 and 9. Proposed: Rule 4.06.		By agency on the basis of a review of data obtained by investigation directed by the Board and by holding a public hearing to hear complaints.					Accidental or other infrequent emissions of odors. Natural odors resulting from the normal production and cultural practices of agriculture Incinerators with a rated heat input of $\geq$ 40 million BTU per hour.	No owner shall allow the emission into the outdoor atmosphere of any odor which is determined by the Board to be objectionable to the extent that it causes an unreasonable interference with human life or the reasonable use of property. No person shall cause, suffer, allow or permit any plant engaged in the processing of animal, mineral, vegetable, or plant matter to be operated without employing suitable measures, for the control of odorous emissions including wet scrubbers, incinerators, or such other devices as may be approved by the Board.[d] No owner shall allow the operation of an incinerator so as to discharge into the outdoor atmosphere...odor sufficient to cause a condition of air pollution. Incinerators, including all associated equipment and grounds, shall be designed, operated and maintained so as to prevent the emission of objectionable odors. Installation or use of any device or means which conceals or dilutes an emission of air contaminant which would otherwise violate these regulations is prohibited (this section does not prohibit the construction of a stack or chimney).

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City of Alexandria Health Department	Yes.[a] Guide for Odor Control, No. 5. Proposed: Sec. 3B-7.		By persons,[fm] occupying or frequenting places close to, but beyond the property line of the source of odors. By agency, after investigation directed by Director and holding of a public hearing to hear complaints.[a]	Scentometer may be used					No person or owner shall cause, permit or allow the emissions of any odor into the outdoor atmosphere which results in air pollution. No owner or person shall use or operate any article, machine, equipment or other contrivance for the reduction of animal matter by any heated process, including rendering, cooking, drying, dehydrating, digesting, evaporating and protein concentrating unless odor control devices and procedures acceptable to the (Department) are provided. No owner or person shall transport, haul or move in any vehicle or conveyance materials causing or giving rise to odors resulting in air pollution. No person shall cause, suffer, allow or permit any source to discharge air contaminants which cause an objectionable odor or create a nuisance without employing adequate measures for the control of odorous emissions as may be approved by the Director.[a]
Arlington County	Yes. Air Pollution Control Ordinance, Sec. 32-9 (b2, c1, and e5).				If objectionable odors resulting from the burning of refuse in fuel-burning equipment are detectable beyond the premises on which the installation is located.			Malfunction of equipment[y]	No owner shall cause, suffer or allow any emissions of gases, vapors or odors beyond the property line from which such emissions occur, to be in sufficient quantities and of such characteristics and duration as is or is likely to be injurious to the public welfare, to the health of human, plant or animal life, or to property, or which interferes with the enjoyment of life and property. The burning of refuse in fuel-burning equipment is prohibited except in equipment from which ...no objectionable odors arising from the installation are detectable beyond the premises on which the installation is located. Installation or use of any equipment for the sole purpose of concealing an unlawful emission is prohibited.
Fairfax County Health Department Division of Environmental Health (continued on the next page)	Yes. Air Pollution Control Ordinance, Chap. 1A-9, Par. C.								No owner shall cause or allow any emissions of gases, vapors or odors beyond the property line from which such emissions occur to be in sufficient quantities and of such characteristics and duration as is or is likely to result in air pollution. In the absence of appropriate control measures

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(continued) Fairfax County Health Department, Division of Environmental Health									no owner shall use products which, either by themselves or due to additives or impurities, result in air pollution.
City of Roanoke Air Pollution Control	No								
Roanoke County Health Department, Air Pollution Control Division	Yes. Air Pollution Control Ordinance, Sec. 8 (C, F, and G).							Malfunction of equipment[y]	No person shall cause, suffer, or allow any emissions of gases, vapors, or odors beyond the property line from which such emissions occur, when determined by the Director to be in sufficient quantities and of such characteristics and duration as is or is likely to be injurious to the public welfare; to the health of human, plant, or animal life; or to property; or which interferes with the reasonable use of property. In the absence of appropriate control measures, no person shall use products which, either by themselves or due to additives or impurities result in air pollution. Installation or use of any equipment for the sole purpose of concealing an unlawful emission is prohibited.
Virgin Islands Virgin Islands Department of Health, Division of Environmental Health	No								
Washington State of Washington Department of Ecology	No								

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Northwest Air Pollution Authority	Yes								Effective control facilities and measures shall be installed and operated to reduce odor-bearing gases or particulate matter emitted into the atmosphere to a reasonable minimum. The Board or Control Officer may establish reasonable requirements that the building or equipment be closed and ventilated in such a way that all the air, gases and particulate matter are effectively treated for removal or destruction of odorous matter...before emission into the atmosphere. The ambient air shall not contain odorous substances, such as (but not limited to) hydrogen sulfide, mercaptans, organic sulfides and other aromatic and aliphatic compounds, in such concentration or of such duration as will threaten health or safety or prevent the enjoyment and use of property.
Olympic Air Pollution Control Authority	Yes. Regulation 1, Secs. 9.11, 9.01(b5), 9.13, and 9.15.							Upset conditions and/or breakdown of equipment^{y}	Effective control apparatus and equipment shall be installed and operated to reduce odor-bearing gases or particulate matter emitted into the atmosphere to a minimum, so as not to create air pollution. The Board may establish requirements that the building or equipment be closed and ventilated in such a way that all the air, gases and particulate matter are effectively treated for removal or destruction of odorous matter... before emission to the outdoor atmosphere. No material containing asphalt, petroleum products, paints, rubber products, plastic or any substance which normally emits dense smoke or obnoxious odors will be burned. Installation or use of any device or means to conceal or mask an emission of air contaminant which would otherwise violate these rules is prohibited.
Puget Sound Air Pollution Control Agency (continued on the next page)	Yes. Regulation 1, Secs. 9.12, 9.13, and 9.16.							Upset conditions and/or breakdown of equipment^{y}	Effective control facilities and measures shall be installed and operated to reduce odor-bearing gases or particulate matter emitted into the atmosphere to a reasonable minimum. The Board or Control Officer may establish reasonable requirements that the building or

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(continued) Puget Sound Air Pollution Control Agency									equipment be closed and ventilated in such a way that all the air, gases and particulate matter are effectively treated for removal or destruction of odorous matter...before emission to the atmosphere. Installation or use of any device or means to conceal or mask an emission of air contaminant which would otherwise violate these rules is prohibited.
Southwest Air Pollution Authority	Yes. Regulation 2, Secs. 5.03, 5.05, and 5.07; Regulation 1, Secs. 4.01 (bV), 4.05, 4.07, and 4.08.			≥ No. 0 or equivalent dilution (> 1 to < 2 d/t);^{su} ≥ No. 2 or equivalent dilution (> 8 to < 32 d/t).^{w}		2 meas. within 1 hour, at least 15 minutes apart, made off the property surrounding the air contaminant source.		Manufacturing process if highest & best practicable treatment and control currently available is used to maintain lowest possible emission of odorous gases. Upset conditions or breakdown of equipment. Vehicles for transport of passengers or freight. Fuel burning equip. in dwellings for not >4 families. Space heating equipment other than boilers. Internal combustion engines.	No person shall allow, cause, let, permit or suffer the emission of odorous gases from any source, except as provided in this Regulation, in such concentration as to cause a public nuisance or exceed limits shown in other columns. Effective control apparatus and equipment shall be installed and operated to reduce odor-bearing gases or particulate matter emitted into the atmosphere to a reasonable minimum, so as not to create air pollution. The Board may establish reasonable requirements that the building or equipment be closed and ventilated in such a way that all the air, gases, and particulate matter are effectively treated for removal or destruction of odorous matter...before emission into the ambient air. No material containing asphalt, petroleum products, paints, rubber products, plastic or any substance which normally emits dense smoke or obnoxious odors will be burned. Installation or use of any device or means to conceal or mask an emission of an air contaminant which would otherwise be considered a violation is prohibited.

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Spokane County Air Pollution Control Authority	Yes. Regulation I, Sec. 6.04.								Effective control apparatus and measures shall be installed and operated to reduce odor-bearing gases and particulate matter emitted into the atmosphere to a reasonable minimum. The Board or Control Officer may establish reasonable requirements that the building or equipment be closed and ventilated in such a way that all the air, gas, and particulate matter are effectively treated for removal or destruction of odorous matter...before emission to the atmosphere.
Yakima County Clean Air Authority	Yes. Regulation I, Secs. 5.01, 5.04, 5.05, and 5.06.							Upset conditions or break-down of equipment. Fuel-burning equipment for domestic housing.	All air contaminant sources emitting odor bearing gases and odor bearing particulate matter shall be operated or controlled in such a manner as to eliminate as far as practicable noxious odors. Proven technological improvements, to the extent that the same are economically feasible, shall be incorporated in such air contaminant sources to reduce the emission of noxious odors in the ambient air. No person shall ignite, cause to be ignited, permit to be ignited or suffer, allow or maintain any open fire within the jurisdiction of the Authority except as provided in another section and no person shall burn in any open fire any material containing asphalt, petroleum products, paints, rubber products, plastics or any substance which normally emits dense smoke or obnoxious odors. Installation or use of any device or means to conceal or mask an emission of air contaminant which would otherwise be considered a violation is unlawful.
West Virginia West Virginia Air Pollution Control Commission	Yes. Administrative Regulations, Secs. 2 and 6.		By Commission representative based on his investigations or his investigations and complaints	Scentometer may be used				Internal combustion engines. Agricultural production operations.	No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor at any location occupied by the public.

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City of Wheeling Air Pollution Control Department	Yes. Air Pollution Control Ordinance, Secs. 2 (i and g), 4, and 2(h).		By persons;[hmt] By persons,[hm] after dilution with odor free air: 20 vol.[v] 4 vol.[w]					Upset conditions or breakdown of equipment[y]	It is unlawful for any person to permit or cause the emission of such quantities of air contaminants from whatever source in such place or manner as to be detrimental to any person or to the public or to endanger the health, comfort or safety of any person or the public, or in such manner as to cause or have a tendency to cause injury or damage to property or business.[z] No person shall emit odorous matter such as to cause an objectionable odor on or adjacent to residential, recreational, institutional, retail sales, hotel or educational premises; on or adjacent to industrial or other premises as shown in another column. Installation or use of any equipment for the sole purpose of diluting or concealing an emission is prohibited.
Wisconsin State of Wisconsin Department of Natural Resources, Bureau of Air Pollution Control and Solid Waste Disposal	Yes. Air Pollution Control Rules, NR 154.08, and NR 154.03(5).								No person shall emit into the ambient air malodorous substances at levels which cause air pollution. A person shall maintain his premises, and materials stored on his premises, so as to minimize air pollution from...odors. Materials moved on public roads, railroads, and navigable waters shall be secured and protected in such a manner as to minimize the spreading of ...odor...
Eau Claire City-County Board of Health	Yes. Air Pollution Ordinance, Summary and Sec. III.								No person shall use or have under his control any equipment or process which causes, creates, modifies, handles, conveys, controls, discharges or comes in contact with air pollutants which are subsequently discharged to the atmosphere.[z] Open burning is prohibited in any residential areas and any areas where air pollution would result.[z]
City of Green Bay Department of Air Pollution Control	No.								

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		No. of Complaints	If Deemed Offensive/ Objectionable	Dilution Device Reading	If Detectable	Frequency of Odor	Duration of Odor		
Milwaukee County Department of Air Pollution Control	No.[b] Proposed: Air Pollution Control Ordinance, Sec. 1, Sec. 89.11(8).								No person shall cause or allow to be emitted into the open air from any process or control equipment, internal combustion engine, premises, or open fire, any air pollutants in a manner to cause injury, detriment, nuisance, or annoyance, or to endanger the health or safety of any person, or to cause or have a natural tendency to cause injury or damage to business or property or to interfere with the reasonable use and enjoyment of life and property.[z]
Wyoming State of Wyoming Department of Health and Social Services, Division of Health and Medical Services	Yes. Air Quality Standards and Regulations, Secs. 5, 6, and 13.	One[e]		No. 2 odor strength		2 measurements within 1 hour, at least 15 minutes apart		Equipment used exclusively for the processing of food for human consumption in food service establishments. Abnormal conditions and equipment malfunction.[y]	No person shall cause or permit odorous emissions so as to cause air pollution. An odor occurrence shall be deemed a violation under the conditions stated in the other columns. No person shall operate or use any device, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors, and gas-entrained effluents from such facility are incinerated at a temperature ≥1200°F for a period ≥0.3 second, or processed in such manner as determined by the Division to be equally or more effective for the purpose of air pollution control. A person incinerating or processing gases, vapors or gas-entrained effluents pursuant to this rule shall provide, properly install and maintain, in good working order and in operation, devices as specified by the Division for indicating temperature, pressure, or other operating conditions. Effective devices and/or measures shall be installed and operated such that no vent, exhaust pipe, blow-off pipe or opening of any kind shall discharge into the outdoor air any odorous matter, vapors, gases, or dusts or any combination thereof which creates odors or other nuisances in the neighborhood of the plant. Odor producing materials shall be stored and handled in a manner such that odors produced from such materials are confined. Accumulation of odor producing materials resulting from spillage or other escape is prohibited. Odor bearing gases, vapors, fumes or dusts arising from materials in process shall be confined at the point of origin so as to prevent liberation of odorous matter.

APPENDIX B

REQUIREMENTS FOR AGENCY PARTICIPATION

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APPENDIX B

REQUIREMENTS FOR AGENCY PARTICIPATION

PURPOSE AND SCOPE OF THE PROGRAM

Copley International Corporation has been retained by the Environmental Protection Agency to develop a model odor control ordinance for the purpose of assisting state and local authorities in combating community odor problems. This project, under EPA Contract No. 68-02-0095, represents the culmination of two and one half years of continuous odor problem research by Copley International Corporation for the federal government.

The project was designed to include a comprehensive evaluation of the model ordinance and a set of procedures developed for use in connection with the model ordinance. The evaluation is to be conducted by four air quality enforcement agencies, each to be selected by the following criteria:

- Location in a metropolitan area having numerous possible community odor problems.
- Known involvement in the study and control of community odor problems.
- Willingness to complete the requirements specified below.

PERIOD OF PARTICIPATION

Participation of a selected agency would be for a period of seven months, beginning January 17, 1972. The first six months would be devoted to the application of the enclosed "Procedures for the Identification and Assessment of Community Odor Problems" to actual chronic situations in the jurisdiction of the agency. This application would be in connection with the attached "Tentative Model Odor Control Ordinance." Although agency evaluation of the procedures and tentative model ordinance would continue throughout the first six months and although agency comments would be accepted by Copley International Corporation at any time, a formal statement of agency recommendations would not be required until the seventh month.

SPECIFICS OF THE PROGRAM

Preliminary Activities

After agreement by the agency director to participate in the program, representatives of Copley International Corporation and Pope, Evans and Robbins, Inc. (the project subcontractor), would travel to the agency to hold discussions with the agency officials. This would occur approximately four weeks before the beginning of the application and evaluation period.

The officials would be instructed in the use of the enclosed manual. Special emphasis would be placed on such complex tasks as the delineation of test and control areas, analysis of public attitude survey results, proper use of the scentometer, and training and deployment of odor judgment panelists. The officials would be asked to focus their evaluation on:

- The complexity of the procedures versus the skills possessed by their personnel.
- The costs involved.
- The information obtained versus that needed to support effective odor control activities.
- The overall utility of the procedures.

The discussions would then be centered on the basis of the tentative model ordinance. Initial recommendations of the officials for changes in the structure and content of the tentative version would be covered at that time.

Application of the Procedures (Field Work)

Application of the procedures to actual chronic situations would be directed by agency officials alone. Copley International Corporation and Pope, Evans and Robbins, Inc., would provide guidance only when called upon to do so. Such guidance would be advisory in nature and would consist of answering specific questions. However, all four agencies participating in the program would be informed of any developments that would benefit the program as a whole.

During the first six months of agency participation, the agency would be required to complete a minimum of 12 public attitude surveys in accordance with the procedure for problem identification. Six of these surveys would be conducted in possible odor problem communities ("test areas") and six would be conducted in matched odor free communities ("control areas"). Source verification would be required for each test area in which an odor problem is identified.

Evaluation of the Procedures and Model Ordinance

Representatives of Copley International Corporation and Pope, Evans and Robbins, Inc., would visit the selected agencies twice during the field work. Both visits would be for the purpose of inspecting the progress of evaluation. The first visit would occur sometime in the third month of the field work.

A comprehensive evaluation form would be prepared by Copley International Corporation to assure that the evaluation data reported by each of the four agencies are comparable. The form — a series of open ended questions — would be made available to the agency officials during the second visit, which would occur about two weeks before the end of the field work.

During the seventh month of agency participation, agency officials would be required to complete the evaluation form and submit it to Copley International Corporation. The evaluation data would be reviewed extensively. Omissions and ambiguous statements would be discussed with the appropriate officials. Similarly, unusual findings would be verified for accuracy.

REPORT ON THE RESULTS

A report on the results of the project would be prepared by Copley International Corporation for the Environmental Protection Agency. A copy of the report would be presented to each of the agencies that participated.

REIMBURSEMENT OF ACTUAL EXPENSES

Copley International Corporation will reimburse each agency that completes the requirements of the program up to $6,000 for actual expenses incurred in applying the procedures to actual chronic situation

PROCEDURE GUIDANCE

The following individuals would be contacted for guidance related to the application of the procedures:

Mr. R. David Flesh
Project Director
Copley International Corporation
7817 Herschel Avenue
La Jolla, California 92037
(714) 454-0391, ext. 246

Mr. James C. Burns
Senior Staff Chemist
Pope, Evans and Robbins, Inc.
564 Market Street, Suite 300
San Francisco, California 94104
(415) 981-7903

APPENDIX C

INTERVIEW EXAMPLES USED TO TRAIN AGENCY PERSONNEL

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APPENDIX C

INTERVIEW EXAMPLES USED TO TRAIN AGENCY PERSONNEL

The following are transcribed examples of simulated telephone interviews used to train air pollution control agency personnel in preparation for conducting the public attitude surveys described in the procedure for problem identification. The examples were recorded on magnetic tape. Copies of the tape were given to the project supervisor at each of the participating agencies.

INTERVIEW EXAMPLE NO. 1

This example depicts an almost ideal situation in which the respondent answers all questions with little hesitation. Although few interviews will actually progress this smoothly, the example can be used to familiarize the trainee with the questionnaire and the technique of telephone interviewing. Duration of the interview is two minutes.

Respondent: Hello.

Interviewer: "Hello. My name is Marian Olson. I'm calling for a government agency interested in certain community problems. I'd like to talk with the lady of the house and get her opinion on a few questions. Are you the lady of the house?"

Respondent: Yes, I am.

Interviewer: "Have you lived at your present address more than six months?"

Respondent: Yes, I have.

Interviewer: "Lately, people have become very much concerned about the environment and various types of pollution. Do people complain about any kind of pollution in your neighborhood?"

Respondent: Yes, they do.

Interviewer: "Do they complain about air pollution in your neighborhood?"

Respondent: Uh...yes, they do.

Interviewer: "Water pollution in your neighborhood?"

Respondent: No...no, not water pollution.

Interviewer: "Airport, industrial, or traffic noise in your neighborhood?"

Respondent: No.

Interviewer: "Noticeable odors in your neighborhood?"

Respondent: Yes, there are some noticeable odors in the neighborhood.

Interviewer: "Have you noticed any odors in your neighborhood in the last three months?"

Respondent: Yes, I have.

Interviewer: "How often have you noticed these odors?"

Respondent: Oh, about once a day.

Interviewer: "Generally speaking, how long do these odors last?"

Respondent: Oh...about half an hour or more.

Interviewer: "How strong would you say these odors smell?"

Respondent: Oh, quite strong.

Interviewer: "Would you say very strong, strong...?"

Respondent: Yes, very strong.

Interviewer: "When was the last time you noticed odors in your neighborhood?"

Respondent: Uh...yesterday.

Interviewer: "Would you say these have bothered you?"

Respondent: Yes, they do.

Interviewer: "How much would you say they have bothered you? Would you say very much, much...?"

Respondent: Very much.

Interviewer: "Where would you say most of these odors originate, that is, who or what causes them?"

Respondent: My guess would be the oil refinery.

Interviewer: "All this information is strictly confidential, but we need it for statistical purposes. What company do you work for?"

Respondent: I'm a housewife.

Interviewer: "What companies do other members of your family work for?"

Respondent: My husband works for the Widget Company.

Interviewer: "That completes the interview. Thank you very much for your time."

Respondent: Thank you.

Interviewer: Bye.

INTERVIEW EXAMPLE NO. 2

The respondent hangs up! Occasionally, a respondent will be pressed for time or, for various reasons, will not wish to be interviewed. His/her cooperation should be solicited, but not forcefully nor persistently. Duration of the incompleted interview is one minute.

Respondent: Hello.

Interviewer: "Hello. My name is Marian Olson. I'm calling for a government agency interested in certain community problems. I'd like to talk with the lady of the house to get her opinion on a few questions. Are you the lady of the house?"

Respondent: Yes, I am.

Interviewer: "Have you lived at your present address more than six months?"

Respondent: Yes.

Interviewer: "Lately, people have become very much concerned about the environment and various types of pollution. Do people complain about any kind of pollution in your neighborhood?"

Respondent: What kind of pollution are you interested in?

Interviewer: "Do people complain about any kind of pollution in your neighborhood?"

Respondent: I believe you already said that.

Interviewer: I'm sorry. I'm allowed only to repeat the question, not to comment on it. I'll be happy to repeat it again.

Respondent: Are you trying to sell me a product?

Interviewer: No. We're asking a few questions about the environment, and we'd appreciate your cooperation in answering them.

Respondent: I think that this is going to take too much time for me.

Interviewer: We'd appreciate your cooperation.

Respondent: No, I'm really not interested. (Click!)

INTERVIEW EXAMPLE NO. 3

The respondent requires prompting on several questions. The interviewer maintains strict control by repeating the question several times. To reduce the possibility of antagonizing the respondent, the interviewer could have said, "I'm sorry. I am not permitted to comment on the questions, but I may repeat them if you wish." Duration of the interview is three and a half minutes.

Respondent: Hello.

Interviewer: "Hello. My name is Marian Olson. I'm calling for a government agency interested in certain community problems. I'd like to talk with the lady of the house to get her opinion on a few questions. Are you the lady of the house?"

Respondent: Yes, I am.

Interviewer: "Have you lived at your present address more than six months?"

Respondent: Yes.

Interviewer: "Lately, people have become very much concerned about the environment and various types of pollution. Do people complain about any kind of pollution in your neighborhood?"

Respondent: Well...uh...what type of pollution?

Interviewer: "Do people complain about any kind of pollution in your neighborhood?"

Respondent: Oh...yes, they do. Are you trying to sell me a product?

Interviewer: No, we're just asking a few questions about the environment, and we'd appreciate your cooperation.

Respondent: I see. OK.

Interviewer: "Do people complain about air pollution in your neighborhood?"

Respondent: Yes.

Interviewer: "Water pollution in your neighborhood?"

Respondent: No.

Interviewer: "Airport, industrial, or traffic noise in your neighborhood?"

Respondent: No, not in this neighborhood.

Interviewer: "Noticeable odors in your neighborhood?"

Respondent: Yes...noticeable odors. I could say that.

Interviewer: "Have you noticed any odors in your neighborhood in the last three months?"

Respondent: Yes.

Interviewer: "Have...how often have you noticed these odors?"

Respondent: Um...about once a week.

Interviewer: "Generally speaking, how long do these odors last?"

Respondent: Uh...you mean during the daytime or during the evening?

Interviewer: "Generally speaking, how long do these odors last?"

Respondent: Oh...about a half hour altogether.

Interviewer: "How strong would you say these odors smell? Would you say very strong, strong, moderate, or slight?"

Respondent: Oh...I would say strong.

Interviewer: "When was the last time you noticed odors in your neighborhood?"

Respondent: Well, the last time I noticed that people were complaining about odors...was last week.

Interviewer: "When was the last time you noticed odors in your neighborhood?"

Respondent: Last week.

Interviewer: "Would you say these odors have bothered you?"

Respondent: Yes, they have.

Interviewer: "How much would you say they have bothered you? Would you say very much, much, moderately, or little?"

Respondent: I would say they have bothered me...much.

Interviewer: "Where would you say most of these odors originate, that is, who or what causes them?"

Respondent: Um...can you give me a few ideas?

Interviewer: "Where would you say most of these odors originate, that is, who or what causes them?"

Respondent: Uh...you mean specific companies, or do you mean...uh...areas?

Interviewer: "Where would you say most of these odors originate, that is, who or what causes them?"

Respondent: Oh...then I couldn't tell you. I really don't know.

Interviewer: "All this information is strictly confidential, but we need it for statistical purposes. What company do you work for?"

Respondent: I'm a housewife.

Interviewer: "What companies do other members of your household work for?"

Respondent: My husband works for the Widget Company.

Interviewer: "That completes the interview. Thank you very much for your time."

Respondent: You're welcome.

Interviewer: Bye.

INTERVIEW EXAMPLE NO. 4

Interviewer leads the respondent in answering several questions. Such a practice should be avoided, since it usually injects unmeasurable bias into the results of the survey. Duration of the interview is three minutes.

Respondent: Hello.

Interviewer: "Hello. My name is Marian Olson. I'm calling for a government agency interested in certain community problems. I'd like to talk with the lady of the house to get her opinion on a few questions. Are you the lady of the house?"

Respondent: Yes, I am.

Interviewer: "Have you lived at your present address more than six months?"

Respondent: Yes, I have.

Interviewer: "Lately, people have become very much concerned about the environment and various types of pollution. Do people complain about any kind of pollution in your neighborhood?"

Respondent: No, I haven't heard them complain about it.

Interviewer: "Do people complain about air pollu..." Oh, I'm not supposed to ask you that question. Just a minute; I'll have to look here and see what I'm supposed to do next.

Respondent: Oh. OK.

Interviewer: Um..."Have you noticed any odors in your neighborhood in the last three months?"

Respondent: Uh...yes, I have.

Interviewer: "How often have you...have you noticed these odors?"

Respondent: Oh...I really couldn't tell you that. I don't know.

Interviewer: Well, I mean, like once a week...or once a month, or...maybe every day?

Respondent: I notice it in the morning mostly.

Interviewer: Oh...uh...

Respondent: About an hour, maybe.

Interviewer: OK. Now, let's see what I'm supposed to ask you. Um... "Generally speaking, how long do these odors last?" Oh! You already said an hour. Uh...is that right?

Respondent: Uh...that's approximately right, yes.

Interviewer: OK...Um...Now this is a really dumb question. I hate to have to ask it but...well, it's on here and I have to. "How strong would you say these odors smell? Would you say very strong, strong, moderate, slight, don't know..." Oh! I'm not supposed to read the "don't know" part.

Respondent: Oh. I would say strong...they smell quite strong.

Interviewer: "When was the last time you noticed the odors in your neighborhood?"

Respondent: Last week...no, make it this week. This week I noticed it.

Interviewer: Um...this is another dumb question. "Would you say these odors have bothered you?"

Respondent: Well, of course they have! If I noticed them, they bothered me.

Interviewer: "How much would you say they bothered you?"

Respondent: Well, I thought I answered that. Very much!

Interviewer: Oh...OK...Yes, I guess you did answer that. Uh..."Where would you say most of these odors originate, that is, who or what causes them?"

Respondent: Oh, I really don't know. I...I couldn't answer that.

Interviewer: You don't think it might be the Widget factory in your area, do you?

Respondent: Uh...it could be, but I don't know for sure.

Interviewer: Um...Now I gotta say another dumb thing. "All this information is strictly confidential, but we need it for statistical purposes. What company do you work for?"

Respondent: I'm a housewife.

Interviewer: Oh. "What companies do other members of your household work for?"

Respondent: Well, my husband works for the Widget Company.

Interviewer: Well, I guess that's about it. Um...it says here to say, "That completes the interview," and to thank you very much for your time.

Respondent: Oh, you're welcome. Thank you.

Interviewer: Bye.

INTERVIEW EXAMPLE NO. 5

Respondent leads the interviewer. As in Example No. 4, this situation usually produces unmeasurable bias and, therefore, should be avoided. Of equal importance, the inadequate control maintained by the interviewer unnecessarily increases the survey time and cost. Duration of the interview is six and a half minutes.

Respondent: Hello.

Interviewer: "Hello. My name is...is Marian Olson. I'm calling for a government agency interested in certain community problems. I'd like to talk with the lady of the house to get her opinion of a few questions. Are you the lady of the house?"

Respondent: Yes, I am.

Interviewer: "Have you lived at your present address more than six months?"

Respondent: Oh...yes. Oh, longer than that. Yes, much longer.

Interviewer: Uh..."Lately people have become very much concerned about the environment and various types of pollution. Do people complain about any kind of pollution in your neighborhood?"

Respondent: Oh, all kinds. Yes, they talk about air pollution and the smog and water pollution and the bay, the...Oh, haven't you noticed?

Interviewer: Well, yes...uh...yes. You know, it's just all over the whole area. The...

Respondent: Doesn't it bother your eyes?

Interviewer: Oh, yes. Some days I can hardly see to drive to work because the air pollution is so bad.

Respondent: I know. You know, if it weren't for my contact lenses, I...I'd probably have a really bad problem.

Interviewer: Well, you know, sometimes I arrive at work and my eyes are so red I look like I've been crying. I don't know what my boss thinks about that.

Respondent: Oh, I know. You can go through a box of Kleenex in one day. I know. It affects my sinuses...just everything.

Interviewer: Oh, it sure does. It's really bad. Uh...I'm...The next question I have to ask you is, "Have you noticed any odors in your neighborhood in the last three months?"

Respondent: Oh, yes. I've noticed that. Oh, all kinds of odors...in the airport, in the traffic. I've noticed it just opening my windows. Sometimes I can't even do that. I've...Oh, everybody complains about the odors. We don't know if...it could be the oil refinery.

Interviewer: Yes, well...you know...I think they've got to do something about these industries that are putting all these odors in the air. They're just awful! They're just awful!

Respondent: I know. And it could probably affect your laundry, too.

Interviewer: Yes. Well, you know, I...I'd like to hang my clothes outside, but I just can't anymore because they don't smell fresh when I bring them in.

Respondent: You know, I've used that non-polluting laundry detergent and... uh...I hope I'm doing my part.

Interviewer: Well...I'm sure you are. I'm sure you are.

Respondent: Are you selling that?

Interviewer: Oh, no. This is just a bunch of...of questions about...uh... odors and things like that.

Respondent: Oh. Who's the study for?

Interviewer: Well, it's for a government agency.

Respondent: Oh, which agency is that?

Interviewer: Well, I'm not supposed to tell you until after the interview's over. I'll be glad to tell you when the interview's over, though.

Respondent: Yes, I'd like to know how this turns out. You know, I want to see something done about this.

Interviewer: Well...I've got some more questions to ask you...

Respondent: Oh...OK. Fine. Go right ahead.

Interviewer: You said you noticed odors. "How often have you noticed these odors?"

Respondent: Oh, I'd say about once a week...at least.

Interviewer: And..."Generally speaking, how long do these odors last?"

Respondent: Oh...a good part of the morning.

Interviewer: Um..."How strong would you say the odors smell? Would you say very strong, strong, moderate, slight...?"

Respondent: Oh, they're pungent, all right.

Interviewer: Uh...well..."Would you say they were very strong?"

Respondent: Um...very strong...OK. That's a good one.

Interviewer: Uh..."When was the last time you noticed odors in your neighborhood?"

Respondent: Yesterday.

Interviewer: Did you have your laundry out then?

Respondent: I didn't have my laundry out then. I'm trying to gauge my washing with the weather. Can you believe that? Isn't it awful?

Interviewer: Well...it's awful that you have to do that.

Respondent: Right. I just wait until it's a smoggy day or a day when there's odor, and then I wash the next day

Interviewer: Does that really work? I mean, does it usually clear the next day?

Respondent: Yes...it doesn't last that long...quite a few hours, but it doesn't usually go into the next day.

Interviewer: I'll have to try that. I hadn't thought of doing it that way.

Respondent: But you have to get a system with this kind of pollution.

Interviewer: Yeah, I guess you're right. Let's see, I got another question here. Um..."Would you say the odors have bothered you?" Well, I guess you've already said that.

Respondent: I said that. They sure do.

Interviewer: And, uh, "How much would you say they bothered you? Would you say...?"

Respondent: Well, quite a bit.

Interviewer: Uh...like "very much or much or moderate..."

Respondent: Very much. Put me down for very much.

Interviewer: OK. Uh..."Where would you say most of these odors originate, that is, who or what causes them?"

Respondent: Oh, well. I could take a guess. It comes out in the traffic, the oil refinery, the bay, the ocean, the trash, the garbage. Oh...

Interviewer: Yes, I'm sure all of those things that you mentioned are...uh... are things that cause odors. Uh...Do you...?

Respondent: You'd think if they could get a man up in the moon they'd be able to clean up the city a little.

Interviewer: You sure would think so, but I just don't know. I guess they're trying, but, uh...it's kinda hard.

Respondent: Yes. I'd sure like to find out how this survey comes out.

Interviewer: Well, uh...we'll...we'll...

Respondent: Are we finished?

Interviewer: No, I've got a couple more questions here I have to ask.

Respondent: Oh, OK.

Interviewer: Uh..."All this information is strictly confidential, but we need it for statistical purposes. What company do you work for?"

Respondent: I'm a housewife.

Interviewer: "And what companies do other members of your household work for?"

Respondent: Uh, my husband works for the Widget Company.

Interviewer: Oh...Aren't they one of the companies in your area that cause some of the odors?

Respondent: Yes, they are! I bet that's probably one of the main sources right in this particular area.

Interviewer: Well, maybe...

Respondent: I'm appalled that my husband would keep on working for the company...

Interviewer: Maybe he could help the company...

Respondent: ...but you have to have that money coming in.

Interviewer: Maybe he could help the company do something about those awful odors down there.

Respondent: Well, you have to be at the top to do something like that. You know, if you're low man on the totem pole, you can't really do much...

Interviewer: Yes, I...

Respondent: ...except maybe quit!

Interviewer: Yes, I suppose that's right. I suppose that's right.

Respondent: Yes, I think so.

Interviewer: Uh..."This completes the interview. Um...Thank you very much for your time." I told you I would tell you what agency this is for. It's for the Air Pollution Control Agency in the city.

Respondent: Air Pollution Control. Oh...OK.

Interviewer: They're...

Respondent: Is that the same one as the one who's doing all the work on the smog?

Interviewer: Well...Yeah, that is the same one.

Respondent: OK.

Interviewer: Thanks very much. Bye.

APPENDIX D

EVALUATION FORM

APPENDIX D

EVALUATION FORM

INTRODUCTION

The purpose of this form is to provide each participating air pollution control agency with a standardized format for reporting its evaluation of (1) the manual, entitled "Procedures for the Identification and Assessment of Community Odor Problems," and (2) the March 1972 revision of the Tentative Model Odor Control Ordinance. The form is designed to promote the comparability of information supplied by the agencies. It is not meant to limit the extent nor to influence the content of such information. Indeed, each agency is encouraged to supply information in addition to that requested below as may be necessary to assure a complete statement of its evaluation.

The part of the form dealing with the procedure manual should be completed by the agency employee(s) who supervised the problem identification and source verification activities. The part of the form involving the model ordinance should be completed by the agency's attorney or by the agency employee who supervised the problem identification activities in consultation with the agency's attorney. The agency director should review and approve the completed form which must be submitted to Copley International Corporation on or before October 17, 1972.

Space is provided after each question for the agency employee's comments. If additional space is required for a complete statement to any question or for the provision of supplemental information, the blank pages at the end of the form should be used. The back side of the pages should not be used.

EVALUATION OF THE PROCEDURE MANUAL

A comprehensive evaluation of the manual must include a discussion of the preliminary information leading to the use of the procedures, the procedures themselves, and the costs incurred from the usage. (Exception: Since use of the "Procedure for Problem Assessment" found on page 47 of the manual was not required, discussion of this procedure is left at the option of the agency.)

Preliminary Information

The introductory pages of the manual include: (1) a paragraph stating the purpose of the procedures and to whom they are addressed, (2) a background information section to describe the philosophy upon which the procedures are based,

and (3) a conditional use section to list the conditions under which the procedures should be employed.

Q1) Do you feel that the preliminary information adequately describes...?

(a) The purpose of the procedures

(b) The difficulties associated with using analytical equipment or complaints initiated by residents for solving community odor problems

(c) The proper function of complaints

(d) Why public attitude surveys would satisfy public nuisance law

(e) When the use of sensory techniques must be considered

(f) The preference for dealing with emissions of measurable concentrations of substances as possible infractions of air quality standards rather than as possible violations of odor regulations

Q2) Two types of odor situations — "acute episodes" and "chronic situations" — are given. What kind of situations do you feel "acute episodes" and "chronic situations" are meant to describe?

Q3) Is it clear why such situations are distinguished under public nuisance law?

Q4) A "chronic situation" should be considered as a possible odor problem under any of three given conditions. The purpose of the conditions is to prevent unnecessary use of the procedures and, thus, to minimize the costs of investigation. Based on your experience with these conditions during the field activities, do you feel that they are too restrictive, not restrictive enough, or adequate as given? If you are not in agreement with the conditions as given, what changes do you suggest and why? (Please comment on each of the conditions separately.)

Procedure for Problem Identification

This procedure is the key part of the manual. The results obtained from applying the procedure determines whether or not a community odor problem exists in the test area under investigation. Under the provisions of the Tentative Model Odor Control Ordinance, the source of such a problem would be in violation of law.

The procedure contains seven sections: (1) an introductory section, (2) a paragraph advising when to use the public attitude surveys, (3) a section describing the delineation of test and control areas, (4) a section on sample selection, (5) a section on conducting interviews, (6) a result determination section, and (7) a miscellaneous use section. Questions about the latter five sections are posed below. In addition to answering these questions, please complete the following summary information tables.

Table I. Comparison of socioeconomic characteristics of test and control areas. (Complete parts A through H by the chronological order in which each set of public attitude surveys was performed. Explain source of data if different from 1970 U. S. Censuses of Population and Housing Census Tract Reports.)

A.

Characteristic	Test Area	Control Area	Tolerance	Actual Percent Difference
County name			--	--
Census tract no.			--	--
Population			--	--
Median income			± 20%	
Median home value			± 20%	
Median gross rent			± 20%	
Median no. of rooms			± 10%	
Year built (percent)			± 20%	

B.

Characteristic	Test Area	Control Area	Tolerance	Actual Percent Difference
County name			--	--
Census tract no.			--	--
Population			--	--
Median income			± 20%	
Median home value			± 20%	
Median gross rent			± 20%	
Median no. of rooms			± 10%	
Year built (percent)			± 20%	

C.

Characteristic	Test Area	Control Area	Tolerance	Actual Percent Difference
County name			--	--
Census tract no.			--	--
Population			--	--
Median income			± 20%	
Median home value			± 20%	
Median gross rent			± 20%	
Median no. of rooms			± 10%	
Year built (percent)			± 20%	

D.

Characteristic	Test Area	Control Area	Tolerance	Actual Percent Difference
County name			--	--
Census tract no.			--	--
Population			--	--
Median income			± 20%	
Median home value			± 20%	
Median gross rent			± 20%	
Median no. of rooms			± 10%	
Year built (percent)			± 20%	

E.

Characteristic	Test Area	Control Area	Tolerance	Actual Percent Difference
County name			--	--
Census tract no.			--	--
Population			--	--
Median income			± 20%	
Median home value			± 20%	
Median gross rent			± 20%	
Median no. of rooms			± 10%	
Year built (percent)			± 20%	

F.

Characteristic	Test Area	Control Area	Tolerance	Actual Percent Difference
County name			--	--
Census tract no.			--	--
Population			--	--
Median income			± 20%	
Median home value			± 20%	
Median gross rent			± 20%	
Median no. of rooms			± 10%	
Year built (percent)			± 20%	

G. (Applicable to City of Houston, Texas, and Hillsborough County, Florida, only.)

Characteristic	Test Area	Control Area	Tolerance	Actual Percent Difference
County name			--	--
Census tract no.			--	--
Population			--	--
Median income			± 20%	
Median home value			± 20%	
Median gross rent			± 20%	
Median no. of rooms			± 10%	
Year built (percent)			± 20%	

H. (Applicable to City of Houston, Texas, and Hillsborough County, Florida, only.)

Characteristic	Test Area	Control Area	Tolerance	Actual Percent Difference
County name			--	--
Census tract no.			--	--
Population			--	--
Median income			± 20%	
Median home value			± 20%	
Median gross rent			± 20%	
Median no. of rooms			± 10%	
Year built (percent)			± 20%	

Q5) For what reasons did you select each of the test areas?

Q6) How did you select each of the control areas?

Q7) Did you establish the test and control area boundaries coincident with those of census tracts? If not, how did you establish the test and control area boundaries?

Q8) What difficulties, if any, did you encounter in setting up the test and control areas? What do you suggest to avoid these difficulties or to simplify the procedure?

Table II. Summary of public attitude survey results. (Complete parts A through H by the chronological order in which each set of public attitude surveys was performed.)

A.

Information Item	Test Area	Control Area
Survey no.		
Date(s) survey was conducted		
No. of homes in area		
Sampling interval used		
Sample size		
No. of homes called, but not contacted		
No. of interviews refused		
No. of interviews completed		
No. of respondents bothered by odors (Q9)		
No. of respondents who mentioned source being investigated (Q11)		
Value of the normal deviate, z		
Odor problem index no.		

B.

Information Item	Test Area	Control Area
Survey no.		
Date(s) survey was conducted		
No. of homes in area		
Sampling interval used		
Sample size		
No. of homes called, but not contacted		
No. of interviews refused		
No. of interviews completed		
No. of respondents bothered by odors (Q9)		
No. of respondents who mentioned source being investigated (Q11)		
Value of the normal deviate, z		
Odor problem index no.		

C.

Information Item	Test Area	Control Area
Survey no.		
Date(s) survey was conducted		
No. of homes in area		
Sampling interval used		
Sample size		
No. of homes called, but not contacted		
No. of interviews refused		
No. of interviews completed		
No. of respondents bothered by odors (Q9)		
No. of respondents who mentioned source being investigated (Q11)		
Value of the normal deviate, z		
Odor problem index no.		

D.

Information Item	Test Area	Control Area
Survey no.		
Date(s) survey was conducted		
No. of homes in area		
Sampling interval used		
Sample size		
No. of homes called, but not contacted		
No. of interviews refused		
No. of interviews completed		
No. of respondents bothered by odors (Q9)		
No. of respondents who mentioned source being investigated (Q11)		
Value of the normal deviate, z		
Odor problem index no.		

E.

Information Item	Test Area	Control Area
Survey no.		
Date(s) survey was conducted		
No. of homes in area		
Sampling interval used		
Sample size		
No. of homes called, but not contacted		
No. of interviews refused		
No. of interviews completed		
No. of respondents bothered by odors (Q9)		
No. of respondents who mentioned source being investigated (Q11)		
Value of the normal deviate, z		
Odor problem index no.		

F.

Information Item	Test Area	Control Area
Survey no.		
Date(s) survey was conducted		
No. of homes in area		
Sampling interval used		
Sample size		
No. of homes called, but not contacted		
No. of interviews refused		
No. of interviews completed		
No. of respondents bothered by odors (Q9)		
No. of respondents who mentioned source being investigated (Q11)		
Value of the normal deviate, z		
Odor problem index no.		

G. (Applicable to City of Houston, Texas, and Hillsborough County, Florida, only.)

Information Item	Test Area	Control Area
Survey no.		
Date(s) survey was conducted		
No. of homes in area		
Sampling interval used		
Sample size		
No. of homes called, but not contacted		
No. of interviews refused		
No. of interviews completed		
No. of respondents bothered by odors (Q9)		
No. of respondents who mentioned source being investigated (Q11)		
Value of the normal deviate, z		
Odor problem index no.		

H. (Applicable to City of Houston, Texas, and Hillsborough County, Florida, only.)

Information Item	Test Area	Control Area
Survey no.		
Date(s) survey was conducted		
No. of homes in area		
Sampling interval used		
Sample size		
No. of homes called, but not contacted		
No. of interviews refused		
No. of interviews completed		
No. of respondents bothered by odors (Q9)		
No. of respondents who mentioned source being investigated (Q11)		
Value of the normal deviate, z		
Odor problem index no.		

Q9) What difficulties, if any, did you encounter in obtaining samples of test and control area homes to survey? What do you suggest to avoid these difficulties or to simplify the procedure?

Q10) Which of the three conditions listed in the introductory pages of the manual prompted you to conduct each set of surveys?

Q11) What percentage of telephone interviews were conducted at times other than your agency's normal working hours? (Please estimate the percentage for each set of surveys.)

Q12) Was each set of surveys conducted concurrently? If not, why not?

Q13) During each set of surveys, were the interviewers switched about half way through the sample? If not, why not?

Q14) Which of the surveys listed in Table II were replicates of earlier surveys?

Q15) To what extent do you attribute differences between the results obtained from the replicate surveys and those obtained from the earlier surveys to...?

(a) The manner in which the surveys were conducted

(b) Changes at the sources of odors (e.g., changes in production schedules, installation of odor control equipment, etc.)

(c) Changes in meteorological conditions

(d) Other factors (please describe in detail)

Q16) What difficulties, if any, did you encounter in conducting the surveys? What do you suggest to avoid these difficulties or to simplify the procedure? (Please discuss in terms of pretesting, instructing interviewers, and tabulating results.)

Q17) What difficulties, if any, did you encounter in computing the value of the normal deviate, z, and the odor problem index number? What do you suggest to avoid these difficulties or to simplify the procedure?

Q18) What is your opinion of the results obtained from each set of surveys?

Q19) Do you feel that the results justify the effort required to obtain them? If not, why not?

Q20) Do you feel that the procedure for problem identification is applicable to all possible community odor problems within your agency's jurisdiction? If not, why not?

Procedure for Source Verification

Whenever an odor problem has been identified, the source of the odor must be verified if the problem is to be remedied. When the odor is not familiar or occurs downwind of more than one possible source, the specific offender may be difficult to pinpoint. To deal efficiently with such cases, the use of sensory techniques must be considered.

This procedure is to instruct agency personnel in the proper use of two sensory techniques — the scentometer and the odor judgment panel — and in the analysis of data obtained from such use. The procedure contains six sections: (1) an introductory section, (2) a section advising when to use the scentometer, (3) a section advising when to use an odor judgment panel, (4) a proper use section regarding the scentometer, (5) a proper use section regarding the odor judgment panel, and (6) a result determination section. In addition to answering the questions posed below, please complete the following summary information table.

Table III. Summary of odor source information. (Complete parts A through H by the chronological order in which each set of public attitude surveys was performed. Where a complex of odor sources was involved, indicate "complex of odor sources," but provide information only on the source of odors most frequently detected in the test area.)

A.

Information Item	Data
Name of source	
Location of source (address, if applicable)	
Age of source (if applicable)	
Principal line of products (if applicable)	
Census tract no. of test area affected by source	
Chemical name(s) of substance(s) emitted by source and most frequently detected in test area	
No. of odor complaints against source received by agency from all parties during 1972 (year to date)	
1971	
1970	
1969	
1968	
No. of odor complaints against source received by agency from residents of the test area during 1972 (year to date)	
1971	
1970	
1969	
1968	

B.

Information Item	Data
Name of source	
Location of source (address, if applicable)	
Age of source (if applicable)	
Principal line of products (if applicable)	
Census tract no. of test area affected by source	
Chemical name(s) of substance(s) emitted by source and most frequently detected in test area	
No. of odor complaints against source received by agency from all parties during 1972 (year to date)	
1971	
1970	
1969	
1968	
No. of odor complaints against source received by agency from residents of the test area during 1972 (year to date)	
1971	
1970	
1969	
1968	

C.

Information Item	Data
Name of source	
Location of source (address, if applicable)	
Age of source (if applicable)	
Principal line of products (if applicable)	
Census tract no. of test area affected by source	
Chemical name(s) of substance(s) emitted by source and most frequently detected in test area	
No. of odor complaints against source received by agency from all parties during 1972 (year to date)	
1971	
1970	
1969	
1968	
No. of odor complaints against source received by agency from residents of the test area during 1972 (year to date)	
1971	
1970	
1969	
1968	

D.

Information Item	Data
Name of source	
Location of source (address, if applicable)	
Age of source (if applicable)	
Principal line of products (if applicable)	
Census tract no. of test area affected by source	
Chemical name(s) of substance(s) emitted by source and most frequently detected in test area	
No. of odor complaints against source received by agency from all parties during 1972 (year to date)	
1971	
1970	
1969	
1968	
No. of odor complaints against source received by agency from residents of the test area during 1972 (year to date)	
1971	
1970	
1969	
1968	

E.

Information Item	Data
Name of source	
Location of source (address, if applicable)	
Age of source (if applicable)	
Principal line of products (if applicable)	
Census tract no. of test area affected by source	
Chemical name(s) of substance(s) emitted by source and most frequently detected in test area	
No. of odor complaints against source received by agency from all parties during 1972 (year to date)	
1971	
1970	
1969	
1968	
No. of odor complaints against source received by agency from residents of the test area during 1972 (year to date)	
1971	
1970	
1969	
1968	

F.

Information Item	Data
Name of source	
Location of source (address, if applicable)	
Age of source (if applicable)	
Principal line of products (if applicable)	
Census tract no. of test area affected by source	
Chemical name(s) of substance(s) emitted by source and most frequently detected in test area	
No. of odor complaints against source received by agency from all parties during 1972 (year to date)	
1971	
1970	
1969	
1968	
No. of odor complaints against source received by agency from residents of the test area during 1972 (year to date)	
1971	
1970	
1969	
1968	

G. (Applicable to City of Houston, Texas, and Hillsborough County, Florida, only.)

Information Item	Data
Name of source	
Location of source (address, if applicable)	
Age of source (if applicable)	
Principal line of products (if applicable)	
Census tract no. of test area affected by source	
Chemical name(s) of substance(s) emitted by source and most frequently detected in test area	
No. of odor complaints against source received by agency from all parties during 1972 (year to date)	
1971	
1970	
1969	
1968	
No. of odor complaints against source received by agency from residents of the test area during 1972 (year to date)	
1971	
1970	
1969	
1968	

H. (Applicable to City of Houston, Texas, and Hillsborough County, Florida, only.)

Information Item	Data
Name of source	
Location of source (address, if applicable)	
Age of source (if applicable)	
Principal line of products (if applicable)	
Census tract no. of test area affected by source	
Chemical name(s) of substance(s) emitted by source and most frequently detected in test area	
No. of odor complaints against source received by agency from all parties during 1972 (year to date)	
1971	
1970	
1969	
1968	
No. of odor complaints against source received by agency from residents of the test area during 1972 (year to date)	
1971	
1970	
1969	
1968	

Q21) Have any of the sources listed in Table III installed odor control equipment since 1968? If so, for each source, what type of equipment was installed and what was the approximate date of installation?

Q22) Has the total number of potential odor sources in your agency's jurisdiction increased, decreased, or remained about the same since 1968? On what facts do you base your answer?

Q23) Has the total number of "chronic situations" in your agency's jurisdiction increased, decreased, or remained about the same since 1968? On what facts do you base your answer?

Q24) For each community odor problem that you identified, what method did you use to verify the source of the odor? In each case, why did you select that method over other methods?

Q25) Did your agency compare the operation of the scentometer at fixed points with the operation of the device in a moving automobile? If so, was the comparison made on the same date? Was the same odor source used? (Please describe the comparison in detail.)

Q26) What difficulties, if any, did the scentometer operators encounter in using the scentometer? What do they suggest to overcome these difficulties or to simplify the procedure?

Q27) Does your agency have a particular procedure for using the scentometer? (If so, please describe the procedure in detail, particularly how your agency recommends dealing with transient odors.)

Q28) Did you use scentometer measurements to plot peak odor intensities downwind of any of the sources listed in Table III? If so, did the pattern of intensities point toward the source?

Q29) Did your agency employ an odor judgment panel? If so, how were the panelists recruited?

Q30) In your opinion, how effective were the triangle tests and odor intensity (reference standard) tests in training the panelists for field work?

Q31) How many hours do you feel should be spent to adequately train an odor judgment panel? How many hours were spent to train your agency's panel?

Q32) Which of the sources listed in Table III did you select for odor judgment panel evaluations? What substance emitted by this source was most frequently detected in the test area? What reference standard did you prepare to represent this substance?

Q33) Did you conduct any calibration tests in the field? If so, were the results consistent with those obtained during the odor intensity (reference standard) tests? If not, why not?

Q34) What difficulties, if any, did you encounter in conducting odor judgment panel evaluations? What do you suggest to overcome these difficulties or to simplify the procedure?

Q35) Did you use mean odor intensities or percent of time odor was detected by the panelists to plot odor isopleths? If so, did the pattern of isopleths indicate the direction of the source?

Q36) Do you feel that the results from using the scentometer or the odor evaluation panel justify the effort required to obtain them? If not, what other method(s) would you consider for source verification?

Costs Incurred From Using Procedures

Estimates of the costs of services and materials necessary for problem identification and source verification are included in the Appendix of the manual. These estimates are based on 1971 prices averaged for the United States as a whole. Please complete the following actual cost table and answer the questions provided below.

Table IV. Actual costs incurred from using the problem identification and source verification procedures. (Complete parts A through C. Indicate total costs incurred during the field work by cost category.)

A. Public Attitude Survey Costs

Cost Category	Actual Cost	
	Mandays	Dollars
Direct labor:		
Supervisory time		$
Technician time		
Clerical time		
Total direct labor costs	______	$______
Other direct costs (please list):		
Indirect costs (please list):		
Total public attitude survey costs		$______

B. Scentometer Measurement Costs

Cost Category	Actual Cost	
	Mandays	Dollars
Direct labor:		
Supervisory time		$
Technician time		
Clerical		
Total direct labor costs	______	$______
Other direct costs (please list):		
Indirect costs (please list):		
Total scentometer measurement costs		$______

C. Odor Judgment Panel Costs

Cost Category	Actual Cost	
	Mandays	Dollars
Direct labor:		
Supervisory time		$
Technician time		
Clerical time		
Total direct labor costs	______	$______
Other direct costs (please list):		
Indirect costs (please list):		
Total odor judgment panel costs		$______

Q37) How many sets of public attitude surveys did you conduct during the field work (one set of public attitude surveys equals one survey in a test area and one survey in a matching control area)? On how many separate occasions was the scentometer used? How many odor judgment panels were used?

Q38) What percentage of total public attitude survey costs were incurred during ...? (Estimate as closely as possible.)

(a) The first set of surveys
(b) The second set of surveys
(c) The third set of surveys
(d) The fourth set of surveys
(e) The fifth set of surveys
(f) The sixth set of surveys
(g) The seventh set of surveys (if applicable)
(h) The eighth set of surveys (if applicable)

Q39) Did your agency hire any full-time or part-time employees to support its participation in the project? If so, how many employees did your agency hire, and to what tasks were they assigned?

Q40) By approximately what percentages did the actual costs incurred by your agency differ from the estimated costs contained in the Appendix of the manual? (Answer separately for each of the following activities.)

(a) Public attitude surveys
(b) Scentometer measurements
(c) Odor judgment panel evaluations

Overall Evaluation of the Procedure Manual

Please list and discuss any aspects of the manual or of the individual procedures which you feel are particularly helpful in dealing with odor problems in your agency's jurisdiction.

EVALUATION OF THE TENTATIVE MODEL ODOR CONTROL ORDINANCE

The procedures for problem identification and source verification were developed after several years of study to assist governmental agencies in dealing with community odor problems caused, particularly, by industrial operations. The procedures are offered for use in connection with public nuisance law. The philosophy on which they are based is discussed in the introductory pages of the manual.

The Tentative Model Odor Control Ordinance is an advanced draft of a legal model which, after possible refinement, would provide governmental agencies with as scientific a vehicle for taking action as has been yet developed against the sources of community odor problems. To assist in the preparation of the final draft, please answer the following questions.

Specific Questions

Q41) Do you feel that the Tentative Model Odor Control Ordinance is consistent with public nuisance law? If not, why not?

Q42) In your opinion, are the definitions given in Section I sufficiently clear and complete to support the general provision and the procedural establishment of a violation? If not, what changes do you suggest?

Q43) In your opinion, is the general provision stated in Section II a clear and complete statement of what is intended to be prohibited? If not, what changes do you suggest?

Q44) In your opinion, is the procedural establishment of a violation given in Section III sufficiently clear and complete to be understandable to the court and to all parties likely to be involved in the prosecution of an alleged violator of the general provision? If not, what changes do you suggest?

Q45) What additional or alternative sections, if any, do you recommend for inclusion in an odor control ordinance?

Q46) Does your jurisdiction presently have an odor control ordinance? If so, is it a public nuisance law, or does it limit the type, intensity, or other characteristic(s) of odor?

Q47) Would the Tentative Model Odor Control Ordinance be compatible with other air pollution control laws existing within your jurisdiction? If not, why not?

Q48) Would you favor the adoption of the Tentative Model Odor Control Ordinance for use in your jurisdiction? If not, why not?

Other Information

Please discuss any additional aspects of the Tentative Model Odor Control Ordinance, as you may wish.

SIGNATURE OF PROJECT SUPERVISORS AND AGENCY DIRECTOR

Evaluation of the procedure manual was completed by:

Signature:______________________________

Name and Title:______________________________

Signature:______________________________

Name and Title:______________________________

Evaluation of the Tentative Model Odor Control Ordinance was completed by:

Signature:______________________________

Name and Title:______________________________

Signature:______________________________

Name and Title:______________________________

The evaluations were reviewed and approved by:

Signature:______________________________

Agency Director:______________________________

Date:______________________________

PROCEDURES FOR THE IDENTIFICATION AND ASSESSMENT OF COMMUNITY ODOR PROBLEMS

Prepared for the

ENVIRONMENTAL PROTECTION AGENCY
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By

COPLEY INTERNATIONAL CORPORATION
7817 Herschel Avenue
La Jolla, California 92037

Contributions to this manual were made by

POPE, EVANS AND ROBBINS, INC.
564 Market Street
San Francisco, California 94104

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CONTRIBUTIONS

The overall responsibility of this study was undertaken by Mr. R. David Flesh, Director, Environmental Economics, Copley International Corporation. Others who contributed to this manual included:

- Dr. Amos Turk, Project Consultant and Professor, City College of the City University of New York.
- Mr. James C. Burns, Senior Staff Chemist; and Mr. F. M. Cohn, Vice President; of Pope, Evans and Robbins, Inc.
- Mrs. Marian O. Doscher, Senior Industrial Economist; and Mr. R. Paul Weddell, Senior Economist and Statistician; of Copley International Corporation.

TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS AND CONTRIBUTIONS i

LIST OF TABLES v

LIST OF FIGURES vii

FORMS vii

IDENTIFICATION AND ASSESSMENT OF COMMUNITY ODOR PROBLEMS 1

- INTRODUCTION 1
- BACKGROUND INFORMATION 1
- CONDITIONS WARRANTING USE OF THE PROCEDURES 3

PROCEDURE FOR PROBLEM IDENTIFICATION BASED ON BRIEF PUBLIC ATTITUDE SURVEYS 7

- INTRODUCTION 7
- WHEN TO USE PUBLIC ATTITUDE SURVEYS 8
- SETTING UP TEST AND CONTROL AREAS 8
- OBTAINING A SAMPLE 10
- CONDUCTING THE SURVEY 11
- PROBLEM IDENTIFICATION 19
- ALTERNATE MEANS OF PROBLEM IDENTIFICATION 20
- OTHER USES OF SURVEY RESULTS 25
- STATISTICAL REFERENCE SECTION 35

148

TABLE OF CONTENTS (Cont'd)

Page

PROCEDURE FOR SOURCE VERIFICATION BASED ON SENSORY TECHNIQUES 41

INTRODUCTION 41

WHEN TO USE THE SCENTOMETER 41

WHEN TO USE AN ODOR JUDGMENT PANEL 42

THE SCENTOMETER 42

THE ODOR JUDGMENT PANEL 45

SOURCE VERIFICATION 52

OTHER DILUTION DEVICES FOR SOURCE VERIFICATION 53

PROCEDURE FOR PROBLEM ASSESSMENT 59

INTRODUCTION 59

WHEN TO ATTEMPT PROBLEM ASSESSMENT 59

APPENDIX 61

ESTIMATES OF COSTS INCURRED FROM USING PROCEDURES 61

SUGGESTED REFERENCES 66

LIST OF TABLES

Table		Page
1	Example comparison of possible control area with test area by categories of year structure was built	9
2	Numbers of telephones listed for streets that are located within a hypothetical test area	10
3	Sampling interval	11
4	Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.100, OPL = 0.263, $\alpha = 0.05$, $\beta = 0.05$)	21
5	Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.150, OPL = 0.333, $\alpha = 0.05$, $\beta = 0.05$)	21
6	Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.200, OPL = 0.393, $\alpha = 0.05$, $\beta = 0.05$)	22
7	Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.250, OPL = 0.453, $\alpha = 0.05$, $\beta = 0.05$)	22
8	Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.300, OPL = 0.510, $\alpha = 0.05$, $\beta = 0.05$)	23
9	Correction factors for use when sample size is a large fraction of the total number of telephones in the area to be surveyed	37
10	Concentration of reference standard in odorless solvent used to simulate four strengths of the odor expected to be encountered in the test area	48
11	Recommended work schedule	51

LIST OF FIGURES

Figure   Page

1 Recommended form of a model odor control ordinance 5

2 Barnebey-Cheney, Model I-3 Scentometer 43

3 Example of isopleths representing mean odor intensities recorded by odor judgment panelists stationed in a test area at the points indicated 54

4 Example of isopleths representing percentages of time odor was detected by odor judgment panelists stationed in a test area at the points indicated 54

FORMS

PUBLIC ATTITUDE SURVEY OF COMMUNITY ODOR PROBLEMS PROBLEM IDENTIFICATION QUESTIONNAIRE 26

PUBLIC ATTITUDE SURVEY — TABULATION FORM 30

ODOR PROBLEM IDENTIFICATION 33

DETERMINATION OF THE ODOR PROBLEM INDEX 34

SCENTOMETER LOG SHEET 55

ODOR INTENSITY RATING SHEET 56

ODOR INTENSITY RATING SUMMARY SHEET 57

IDENTIFICATION AND ASSESSMENT OF COMMUNITY ODOR PROBLEMS

INTRODUCTION

The procedures described in this manual are designed to assist governmental agencies in dealing with community odor problems caused, particularly, by industrial operations. The procedures are addressed to "local" agencies, since the investigation of community odor problems usually occurs within the public health departments or air quality offices of local government. They are, however, equally applicable to the needs of state agencies operating at the local level. A mechanism for the official use of the procedures in the establishment of a violation is found in the recommended form of a model odor control ordinance given below.

BACKGROUND INFORMATION

The contents of this manual were developed primarily from the results of two studies — the national survey of the odor problem, conducted in 1969, and a study of the social and economic impact of odors, conducted in 1970 and 1971. Both were conducted by Copley International Corporation for the Environmental Protection Agency. Secondarily, the contents evolved from the findings of other research done in the United States and Sweden, and from the opinions of scientists, jurists, and many local agency officials. The contents were then modified in response to the recommendations of four agencies which applied the procedures to actual community odor problems over an eight month period in 1972.

The difficulty with the investigation of community odor problems lies in the lack of objective evidence that such problems exist. Analytical equipment is available to measure low concentrations of a few odorous substances, but even in situations involving such substances, there is no way to translate known concentrations into odor intensities. Equally distressing, there is no way to translate known odor intensities into some form of an odor problem index. Thus, for the present at least, reliance must be placed on the personal evaluations of those who are exposed.

Traditional methods for solving community odor problems include the presentation of subjective evidence to the courts for consideration under public nuisance law which, for remedy, requires substantial and unreasonable interference to any considerable number of persons in the community. The most widely used form of such evidence has been complaints initiated by residents. On the surface, it would seem that such evidence must define the existence of a problem. Yet, under a literal interpretation of public nuisance law, it may not. It is seldom determined from complaints whether the complainants, individually or as a group, actually suffered interference and, if so, whether the interference was substantial and unreasonable.

The procedures described in this manual are offered for use in connection with public nuisance law in lieu of counting complaints or attempting to extract meaningful information from complainants' remarks. Within these procedures, complaints are relegated to a proper function of alerting local authorities to the locations of possible odor problems. The procedures are also offered for use in connection with statutory law in lieu of attempting to base violations on the mere perception of odors or on arbitrary levels of odor intensity.

Problem Identification Based on Public Attitude Surveys

The most direct means of identifying community odor problems is an attitude survey. This stems from the personal nature of odor evaluation and the concept that attitudes reflect personal evaluations. Unlike odor complaints, an attitude survey of a randomly selected sample of residents would satisfy public nuisance law. The random sample would represent "any considerable number of persons." Attitudes expressing annoyance (typical in odor cases) would represent interference.

To determine whether interference is substantial and unreasonable creates a complexity. Equity is involved. It is unfair to find substantial and unreasonable interference on the basis of an arbitrary percentage of residents who express annoyance. Recent studies have found that, even in virtually odor free areas, up to 50 percent of the residents may express annoyance to odors. This is due to a variety of factors including, for example, residents with unusual sensitivity to background odors, feelings against nearby industry, and neurosis.

The procedure for problem identification provides an equitable basis for showing the extent of interference suffered. It is assumed that the percentage of residents who would express annoyance to odors when odors are not present is approximately equal in all communities of similar socioeconomic characteristics in the agency's jurisdiction. (Once established for communities of similar socioeconomic characteristics, the percentages must not be applied to communities of other characteristics in the agency's jurisdiction or to communities of similar characteristics in other agencies' jurisdictions.) This assumption is supported by the results of the study of the social and economic impact of odors. It is also assumed that residents of all communities have equal right to odor free air. By comparing the results of identical attitude surveys conducted in a suspected odor problem community and a similar, but odor free, community, it can be statistically determined if a greater percentage of residents in the former area express annoyance. If so, an odor problem is identified and an equitable basis for showing substantial and unreasonable interference is provided.

Source Verification Based on Sensory Techniques

Whenever an odor problem has been identified, the source of the odors must be found if the problem is to be remedied. When odors are experienced in a community frequently or over long duration, it is common for the residents to know or at least suspect the source. Still, the source must be verified by local authorities.

Source verification is a straightforward endeavor when the odor is easily recognized and only one possible source of such an odor is located near the problem community. In such cases, a simple investigation is adequate. However, when the odor is not familiar or occurs downwind of more than one possible source, the specific offender may be difficult to pinpoint. To deal efficiently with such cases, the use of sensory techniques must be considered. The procedure for source verification describes two of the most successful techniques — one featuring immediate availability; the other, depth of evaluation.

The use of sensory techniques in problem identification may be possible in the future. This alternative to the use of public attitude surveys may save time (including the time of residents who would otherwise be interviewed) and expense without much loss of confidence in the results. What is needed to examine this possibility is concurrent use of the sensory techniques and public attitude surveys recommended by this manual on numerous occasions over time and, based on the results of such use, the development of appropriate dose-response relationships.

Based on the outcome of field activities performed during the study of the social and economic impact of odors, the scentometer or equivalent dilution device is recommended for indicating the locations of possible odor problems during routine surveillance. A condition for its use in this capacity is given in a following paragraph.

Problem Assessment

By problem assessment is meant a determination of the economic and social impact of odors on a community. Such information would support, but not replace, the need for problem identification in odor cases. Tentative methods of problem assessment have been developed, the most comprehensive of which are documented in the final report of the social and economic impact study. However, because they are not yet refined to the level of problem identification and source verification and because they require highly specialized behavioral science skills not possessed by most local agencies, they are not included in this manual.

CONDITIONS WARRANTING USE OF THE PROCEDURES

Two types of odor situations may exist in a community. One may lead to an odor problem; the other does not. They are referred to as breakdown episodes and chronic situations. Reference to "breakdown episodes" is meant to preclude unexpected malfunctions involving industrial processes from prompting investigations of community odor problems. However, a limitation of one day in any three month period is included in the following definition as incentive for industrial operators to minimize the duration of such episodes should they occur, as well as the possibility that such episodes can occur at all.

Breakdown Episodes

A breakdown episode is defined as a causation of odors to persons beyond the property limits of a source, occurring no more than once and lasting no more than one day in any three month period. A breakdown episode involving the emission of measurable concentrations of odorous substances into the atmosphere should be dealt with as a possible infraction of the air quality standards governing such substances. A breakdown episode should not be considered as a possible odor problem regardless of the characteristics of the odors caused.

Chronic Situations

A chronic situation is defined as a causation of odors to persons beyond the property limits of a source occurring more than once or lasting more than one day in any three month period. A chronic situation involving the emission of measurable concentrations of odorous substances should be dealt with as a possible infraction of the air quality standards governing such substances. A chronic situation should be considered as a possible odor problem under any of the following conditions:

(1) If an odor complaint is initiated by a resident of a community and verified by local authorities after the first day of the first occurrence in any three month period.

(2) If odor complaints are initiated by five or more residents of a community, but not verified by local authorities after the first day of the first occurrence in any three month period.

(3) If odors are detected in a community by local authorities on more than one day in any three month period. Such odors must be of sufficient intensity to be detected using a Barnebey-Cheney Model I-3 Scentometer, or equivalent dilution device, set at 7 dilutions to threshold.

The existence of a chronic situation and any of these conditions should be necessary and sufficient for the employment of the following procedures. A mechanism for their official use in the establishment of a violation is given in Figure 1.

Figure 1. Recommended form of a model odor control ordinance.

SECTION I - DEFINITIONS

Chronic Situation - A causation of odors to persons beyond the property limits of a source occurring more than once or lasting more than one day in any three month period.

Community - A group of at least 20 houses, apartments, or rooms occupied as separate living quarters.

Community Odor Problem - A condition which is said to exist when it has been determined, by public attitude surveys of randomly selected samples of residents, that a significantly greater proportion of respondents in a community in which an odor problem is suspected state they were bothered by odors than respondents in an odor free community of similar socioeconomic characteristics.

Odor - Perception of smell, referring to the experience.

Odor Free Community - A community from which no odor complaints have been received by local authorities and in which no odors have been detected by local authorities during the past twelve months.

Odorous Substance - A substance that stimulates the olfactory receptors and, thus, causes odor.

Person - Any person, firm, association, organization, partnership, business trust, corporation, company, contractor, supplier, installer, user, or owner, or any state or local governmental agency or public district, or any officer, agent, or employee thereof.

Significantly Greater Proportion of Respondents - Determination by use of a mathematical test of statistical significance that the difference between the proportion of respondents in one community who gave a particular answer to a survey question and the proportion of respondents in another community of similar socioeconomic characteristics who gave the same answer to the same survey question is an actual difference and not the result of sampling error.

SECTION II - GENERAL PROVISION

No person shall permit, cause, suffer, or allow the emission of odorous substances into the atmosphere that result in a community odor problem from any source under his control.

SECTION III - PROCEDURAL ESTABLISHMENT OF A VIOLATION

Violation of this ordinance shall be established by identification of a community odor problem. Such identification shall be undertaken by the air quality enforcement agency serving this jurisdiction in accordance with the "Procedures for the Identification and Assessment of Community Odor Problems," prepared for the Environmental Protection Agency under Contract No. 68-02-0095, dated March 1973.

Identification of a community odor problem shall require:

(A) the existence of a chronic situation as defined in SECTION I of this ordinance, and

(B) the existence of any of the following conditions:

  (1) if an odor complaint is initiated by a resident of a community and verified by local authorities after the first day of the first occurrence in any three month period, or

  (2) if odor complaints are initiated by five or more residents of a community, but not verified by local authorities after the first day of the first occurrence in any three month period, or

  (3) if odors are detected in a community by local authorities on more than one day in any three month period (such odors shall be of sufficient intensity to be detected using a Barnebey-Cheney Model I-3 Scentometer, or equivalent dilution device, set at 7 dilutions to threshold), and

(C) the determination, by public attitude surveys of randomly selected samples of residents, that a significantly greater proportion of respondents in a community in which an odor problem is suspected state they were bothered by odors than respondents in an odor free community of similar socioeconomic characteristics.

PROCEDURE FOR PROBLEM IDENTIFICATION BASED ON BRIEF PUBLIC ATTITUDE SURVEYS

INTRODUCTION

The following procedure is designed to allow local agencies to conduct, with their own personnel, public attitude surveys to identify community odor problems. If sufficient funds are available to the local agency, a professional interviewing or survey firm could be engaged to perform many of the tasks described in this procedure. However, the additional expense is not necessary if the procedure outlined is followed with care by local agency personnel. It is important to note that failure to adhere to the procedure could lead to survey results that are misleading or meaningless.

Before describing the detailed steps to be undertaken in conducting a public attitude survey, it may be helpful to summarize the major tasks to be completed. These tasks are described in general terms below.

This survey is designed to compare the attitudes of people residing in a community in which an odor problem is suspected with attitudes of similar people residing in an odor free community. Attitudes of both groups are determined by conducting interviews by telephone with residents of both communities. (Tasks followed by an asterisk (*) could be done by an interviewing firm.)

(1) The first task is to define the geographic limits of the possible odor problem community.

(2) Next, a matching odor free community is located.

(3) Utilizing a street address (reverse order) telephone directory, a list of telephone numbers in each community is made, and a sample of these telephone numbers is selected at random.*

(4) Utilizing the questionnaire provided in this procedure, telephone interviews are conducted with the man or lady of the house for each telephone number included in the sample.*

(5) The total number of responses to key questions asked in both communities is then tabulated and compared for problem identification.

(6) Finally, if an odor problem is found, an odor problem index number is calculated.

WHEN TO USE PUBLIC ATTITUDE SURVEYS

A public attitude survey should be conducted only after any of the three conditions stated in the previous section of this procedure indicate the location of a possible odor problem.

SETTING UP TEST AND CONTROL AREAS

The community in which an odor problem is suspected is called the "test area." The first task to be undertaken is to define the geographic limits of the test area. This can be done by driving an automobile in a grid pattern throughout the general area, while noting the boundaries within which the odor is perceived. Meteorological data indicating wind patterns can also be helpful in setting these boundaries, as can complaint patterns.

Next, the socioeconomic characteristics of the test area must be determined. If the boundaries of the test area are coincident with those of a census tract, the following characteristics of the test area should be listed by reference to the latest U. S. Censuses of Population and Housing Census Tract Reports (PHC) covering the agency's jurisdiction: median income for families, median value of owner occupied housing units, median gross rent of renter occupied units, median number of rooms, and year structure was built.

An odor free community must now be located that matches the test area as closely as possible. This community is called the "control area." The following criteria should be used in choosing the control area.

(1) The control area should be as odor free as possible. To ensure this, the local agency should not have received any odor complaints from residents of the area nor detected any odors in the area during the past twelve months.

(2) The control area should be located within ten miles of the test area.

(3) The control area should have similar access to heavily traveled roadways as the test area.

(4) The control area should be located within approximately the same distance from commercial or industrial establishments as the test area.

(5) The median income, home value, and gross rent for the control area should not differ from that of the test area by more than 20 percent. Using the above mentioned Census Tract

Reports, note the four categories of "year structure built" and the corresponding number of homes listed in the census tract to be used as a test area. Find the modal category. Determine the percentage of the total number of structures in the test area built in this category of years. Next, determine the percentage of the total number of structures in a possible control area built in the same category of years. The percentage for the control area should be within 20 percent of that for the test area.

For example, assume the categories and numbers of structures are listed as in Table 1.

Table 1. Example comparison of possible control area with test area by categories of year structure was built.

Category	Test Area Census Tract 219.01	Control Area Census Tract 6.01
1960 to March 1970	312	203
1950 to 1959	1,068	1,926
1940 to 1949	321	185
1939 or earlier	118	197
Total	1,819	2,511

The modal category for census tract 219.01 is 1950 to 1959, at which time 1,068 structures were built. This represents 59 percent of the total number of structures in the test area. During the same category of years, 1,926 structures were built in census tract 6.01. This represents 78 percent of the total number of structures in the possible control area. The difference is 19 percent (78% - 59%), which is acceptable.

(6) The median number of rooms (per housing unit) should not differ by more than 10 percent.

If the community in which an odor problem is suspected is coincident with more than one census tract, it is preferable to use each census tract as a separate test area. However, if the socioeconomic characteristics of the census tracts do not differ in excess of the above criteria, a weighted average of characteristics should be calculated for use in locating a control area. The population of each census tract should be used as the weighting factor.

If the boundaries of the test area are either smaller or larger than a census tract, the agency should enlist the aid of a professional real estate appraiser in locating a suitable control area. An appraiser should be driven through the test area and then asked to suggest the location of a community that would meet as many of the above criteria as possible. To minimize the cost of such a service, the agency may wish to request the loan of an appraiser from the planning (or other) department of the local government.

OBTAINING A SAMPLE

First, list in alphabetical and/or numerical order all of the streets that are located within the test area. Using a street address (reverse order) telephone directory, which can be obtained from the telephone company, count the total number of telephones that are listed for these streets within the test area. To do this, the house number of the first and last house on each street that runs beyond the test area will have to be determined. In this count do not include professional offices, commercial establishments, government offices, or industrial facilities. Next, using a table of random numbers, select one number that falls between the number "1" and the total number of telephones in the test area. Determine by cumulative addition the street on which the sample selection will begin. Finally, refer again to the street address telephone directory. Find the street on which the sample selection will begin, and count down to the starting point, i.e., to the first telephone to be used for the sample. For example, assume the streets listed in Table 2 are located within the test area:

Table 2. Numbers of telephones listed for streets that are located within a hypothetical test area.

Name/Number of Street	No. of Telephones on Street Within the Test Area	Cumulative Total No. of Telephones Within the Test Area
Adams Street	32	32
Baker Street	28	60
Charles Street	32	92
Denver Street	30	122
35th Street	12	134
36th Street	10	144

Assume the random number chosen is 99. Note from the cumulative total column that the starting point must be the seventh telephone (within the test area) listed on Denver Street. Write down this address and telephone number.

Refer to Table 3 to determine the number of telephones to be passed over before a second telephone is chosen (the sampling interval). Continuing the example, since there are 144 telephones in the test area, the sampling interval is 2. Thus, the ninth telephone (within the test area) listed on Denver Street would be the second telephone to be included in the sample. Continue in this manner until all addresses and telephone numbers in the test area have been written down or passed over as part of the sampling interval. It should be noted that, if the starting point is toward the middle of the streets listed (such as Denver Street), when the last street in the test area is reached the sampling should be continued by returning to the first street listed (such as Adams Street).

When this procedure has been completed for the test area, the same thing should be done for the control area. If a multi-family dwelling such as an apartment building is encountered in the test area or the control area, each family should be counted as though they lived in a spearate house. The numerical or alphabetical sequence of apartments is usually listed in the street address telephone directory. This sequence is convenient for purposes of selecting a sample. If more than one telephone number is found for a single family dwelling, count only the first number and ignore any others. If more than one telephone number is found for a multi-family dwelling, count the first number for each family.

Table 3. Sampling interval.

Number of Telephones in the Area	Sampling Interval
1-90	include all telephones
91-180	2
181-270	3
271-360	4
361-450	5
451-540	6
541-630	7
631-720	8
721-810	9
811-900	10
901-990	11
991-1080	12
1081-1170	13
1171-1260	14
1261-1350	15
1351 and over	16

CONDUCTING THE SURVEY

Each time interviews are conducted in the test area, they must also be conducted in a matching control area. This is necessary to permit the statistical comparisons required to verify the findings of the survey. Surveys should be conducted concurrently in the test and control areas. The same control area may be used for different test areas if the residents have the same socioeconomic characteristics as those in a second test area.

Telephone calls to administer the questionnaire should not be made before 9:00 a.m. nor after 9:00 p.m. To reduce the elapsed time needed to complete the telephone calls, the samples should be divided among two or more interviewers. If only two interviewers are used, one should be assigned to call the control area sample while the other calls the test area sample. To reduce the possibility of interviewers biasing the results of the survey, it is desirable to switch the interviewers about halfway through the sample; i.e., after one-half of the telephone calls in the test area have been made by one interviewer, this person should make calls in the control area. The other interviewer should make the balance of the test area calls. A blank copy of the questionnaire will be needed for each telephone number to be called.

If a survey in a test area or control area is not completed in one day, simply complete the required number of interviews between 9:00 a.m. and 9:00 p.m. of the following day. A brief review of the first day's results may suggest a time period (e.g., dinner time) when it is most likely that residents of an area will be at home. Concentrating the remaining calls about such a time would increase the efficiency of interviewing and, thereby, reduce survey costs. For optimum comparability of the test area and control area results, a like percentage of interviews should be completed in both areas during a given period of time.

Pretesting the Survey

Because it is unlikely that local agency personnel are experienced in conducting telephone surveys, it will be of considerable help to pretest the survey. However, the pretest results should not be combined with those of the actual survey.

For the convenience of the agency, five simulated interview examples are included in Appendix C of the final report, "A Study of the Social and Economic Impact of Odors, Phase III." Arrange for the persons who will conduct the telephone interviews to review these examples and to read the "Instructions for Interviewers" section of this procedure. When this has been done, have each interviewer go through the questionnaire asking the questions aloud of another agency employee. Note whether the interviewer is following instructions in every detail, and correct any errors in interviewing technique. Then, select at random five telephone numbers for each interviewer who will participate in the survey. These telephone numbers should be different from those chosen as part of either the test or control area samples. Have each interviewer call five numbers and administer the questionnaire. Again, note whether the interviewer is following instructions, and correct any errors. When each interviewer is thoroughly familiar with the questionnaire and interviewing technique, begin calling the telephone numbers in the test and control area samples.

Instructions for Interviewers

Because people would usually like to tell you what they believe you want to hear, it is important that the interviewer restrict what is said to the questions or comments on the questionnaire. If the interviewer engages in pleasantries or chats with the person answering the questions, the responses received may be different from those that would otherwise be obtained. The interviewer should be particularly careful not to indicate by either comment or tone of voice any reaction to the answers received. It is also important for the interviewer not to reveal the name of the agency conducting the survey nor the reason the survey is being conducted. Some respondents may challenge the interviewer or question the validity of the survey. Such situations must be handled with a great deal of tact on the part of the interviewer. The respondent has the right to determine whether the survey is legitimate, but if information about the agency or the survey is given before the questions are asked, the respondent's answers may not be valid. Therefore, if possible, the interviewer should agree to tell the respondent this information after the questionnaire is completed. If the respondent refuses to continue the interview without this information, the interview should be terminated.

The respondent may suspect that the call is being made in connection with the sale of a product. The interviewer may assure the respondent that this is not the case prior to asking the questions. It may also be necessary to tell the respondent that the answers given will become a part of a statistical summary and individual responses will not be revealed in any way. If required, this may also be done prior to asking the questions.

Never suggest an answer or train of thought to the respondent. Do not prompt in any way. The most important job of an interviewer is to encourage the respondent to express his or her attitudes and to be specific in conveying these attitudes. Close attention to the clarity and completeness of the responses is important. Never talk up or down to a respondent. Do not comment on the meaning of any question or indicate in any way what kind of answers are expected.

If the respondent asks a question or fails to understand or respond to a question, read the question over again more slowly, using a pleasant but neutral tone of voice. On occasion, it may be necessary to repeat a question more than once before obtaining a response. Do not allow any tone of impatience to creep into your voice. If necessary, explain that you are not permitted to discuss the meaning of the questions.

When asking the questions, stress only those words that are underlined. Do not change the wording of any question. These questions have been carefully constructed to obtain the information desired. Do not change the order of the questions from that listed on the questionnaire.

Before making a telephone call, the interviewer should fill out the upper portion of the questionnaire (a copy of the questionnaire is included at the end of this procedure). From the sample listing, fill in the telephone number, street address, and city to which the call will be made. The "File No." blank is provided for identification of the odor source under investigation. This blank should not be filled in until the source has been verified. The "Survey No." blank is provided to allow differentiation between test and control area responses, as well as surveys conducted at a later time. For example, before the first survey of a suspected odor problem, "Survey No. 1A" could be assigned to the test area and "Survey No. 1B" could be assigned to the control area. If the same areas are the subject of another survey at a later date, survey numbers 2A and 2B could be assigned, respectively.

The "Respondent No." should be left blank until tabulation of the survey results is begun. However, the date of the call and the time of day the call is made should be noted on the questionnaire before the call is made.

Interviewer Instructions for Making Calls

Call the telephone number filled in on the questionnaire. If there is no answer or the line is busy, go on to the next telephone number on the list.

If the call is answered, read the opening statement, saying your name in the appropriate place. If the person who answers the telephone is obviously a woman, use the feminine alternatives in the statement; if a man, the masculine alternatives. Children, relatives, or friends living in or visiting the household should not be interviewed. In addition, no person under 18 years of age should be interviewed. Make sure that the person with whom you are speaking is the man or lady of the house. If he or she is not, try to talk with the man or lady of the house. If this cannot be done, terminate the call, check that the interview was not completed, note the reason, and go on to the next telephone number in the sample.

If the man or lady of the house refuses to be interviewed at all, note that the interview was not completed and the reason. "Refused" is a sufficient explanation.

The numbered blanks in the right hand margin of the questionnaire are to be used in tabulating the responses. Do not write in these spaces at this time. Every question has a list of responses after it. Except for question 3, only one answer should be checked. If the respondent gives more than one answer for a question, ask which answer is the best answer to the question. When a question is followed by three dots, such as "How strong would you say these odors smell?

Would you say...?", read the answers provided in the order they are listed, but do not read either the answer numbers or the response "Don't know."

When a question is not followed by three dots, such as "When was the last time you noticed odors in your neighborhood?", do not read the responses. When a question has a space provided for "Other answers," write down everything the respondent says. If local agency secretaries are used as interviewers, they should use only longhand to write down "Other answers."

Interviewer Instructions for Specific Questions

The following instructions should be adhered to in asking the specific questions on the questionnaire.

Question 1. Do not read the responses. If the respondent answers "No," read the statement following the "No" response and terminate the interview.

Question 2. Do not read the responses. If the respondent answers "Yes," ask question 3. If the respondent answers "No" or "Don't know," ask question 4.

Question 3. This question should be asked only of those people who answered "Yes" to question 2. Read the responses, except for "Don't know." Check all answers that the respondent gives to this question.

Question 4. Do not read the responses. If the respondent answers "No," or "Don't know," skip to question 12. If the respondent answers "Yes," ask question 5.

Question 5. Do not read the responses. Check the response that covers a period most like that identified by the respondent. Repeat the question, if necessary, to obtain a response, but do not read the possible responses.

Question 6. Do not read the responses. Check the response that covers a period most like that identified by the respondent. Repeat the question, if necessary, to obtain a response, but do not read the possible responses.

Question 7. Read the responses rather slowly, pausing between each possible response. Do not read "Don't know." Repeat the question and responses, if necessary, to obtain a reply.

Question 8. Do not read the responses. Check the response that covers a period most like that identified by the respondent. Repeat the question, if necessary, to obtain a response, but do not read the possible responses.

Question 9. Do not read the responses. If the respondent answers "No" or "Don't know," skip to question 11. If the respondent answers "Yes," ask question 10.

Question 10. Read the responses rather slowly, pausing between each possible response. Do not read "Don't know." Repeat the question and responses, if necessary, to obtain a reply.

Question 11. Do not read the responses. Clarify the response, if necessary, by asking the respondent to explain more fully what is meant by the answer given. For example, if the respondent says "Some factory," clarification might elicit the answer, "An oil refinery near my neighborhood." Write down any other source(s) identified by the respondent.

Next, read the statement preceding question 12 regarding the confidential nature of the information being gathered.

Question 12. Do not read the responses. Clarify the response, if necessary, as explained under question 11. Write down the other company mentioned by the respondent if the answer is not the source(s) under investigation.

Question 13. Do not read the responses. Clarify the response, if necessary, as explained under question 11. Write down the other companies or employers mentioned if the answer does not include the source(s) under investigation.

Interviewer Instructions for Completing Interviews

Read the statement at the end of the questionnaire and terminate the interview. Write your name in the space provided, and check the space for a completed interview on the first page of the questionnaire. Go on to the next telephone number.

Interviewing should be continued until all of the telephone numbers in the sample have been dialed once. Review the completed questionnaires, and remove those where the answer to either question 12 or question 13 indicates a member of the household is employed by the odor source under investigation. This is recommended because of potential bias the respondent may have either in favor of or against the employer. If the source has not been verified by an agency inspector, this step should be ignored.

Next, count the number of completed questionnaires remaining for the test area. If there are at least 30, the interviewing portion of the survey is complete. If not, continue to interview, utilizing those telephone numbers where no-answers or busy signals were received, until all no-answers or busy signals in the sample have been called a second time. Do the same thing for the control area.

Tabulation

If the local agency has access to electronic data processing equipment, and the number of respondents in either the test or control area exceeds 90, consult with those in charge of such equipment to set up procedures for tabulating the survey. If such equipment is not available or the number of respondents in each area is small, hand tabulating is quite satisfactory.

Regardless of the tabulating procedure utilized, the completed questionnaires must be edited and coded. Editing should be done by persons other than those who conducted the interviews. The purpose of this task is to insure that all questions have been asked and answers recorded. Inconsistencies also can be identified and corrected.

On each questionnaire there should be a response to all appropriate questions. For example, if question 2 concerning people in the neighborhood complaining about pollution has been answered with a "Yes," then question 3 dealing with the kind of pollution people complain about should have also been answered, even if the answer is "Don't know."

The following comments regarding each question on the questionnaire may be used as a guide for editing. If editing uncovers errors or omissions, it may be necessary to call the respondent again to clarify an answer which has been incorrectly recorded or to eliminate an inconsistency.

Question 1. If the response is "No," all other questions on the questionnaire should be unanswered.

Question 2. If the response is "Yes," there should be an answer to question 3. If the response is "No," there should be no response to question 3.

Question 3. There should be no response to this question if question 2 has a "No" reply.

Question 4. If the response is "No" or "Don't know," questions 4, 6, 7, 8, 9, 10, and 11 should not contain responses. If the answer to question 4 is "Yes," questions 4, 6, 7, 8, 9, and 11 must have been answered, also, even if the answer is "Don't know."

Question 5. There should be a reply to this question only if question 4 was answered "Yes." If so, there must be a reply to this question.

Question 6. Same as question 5.

Question 7. Same as question 5.

Question 8. Same as question 5.

Question 9. Same as question 5.

Question 10. If the response to question 9 was "No" or "Don't know," there should be no response to this question. If the response to both question 4 and question 9 was "Yes," this question should have been answered, also.

Question 11. Same as question 5.

Question 12. There should be a response to this question on all questionnaires except those where the response to question 1 was "No."

Question 13. Same as question 12.

When the editing is completed, the questionnaires should be coded. This merely means writing the number of the response to each question on the appropriate line near the right hand margin of the questionnaire. If there was more than one response to question 3, the number of each type of pollution mentioned may be written in the margin.

When the coding is completed, each questionnaire should be numbered on the first page in the blank following "Respondent No." The same sequence of numbers may be used for the test area and the control area, since the areas will be distinguished by the survey numbers assigned earlier.

Tabulation may be accomplished in one of two ways. A form can be designed on which to tally the number of responses of each kind to each question. (A recommended form is provided at the end of this procedure.) An alternative is to sort the questionnaires themselves into stacks according to the answers to a particular question and count the number of questionnaires in each stack. This method tends to be somewhat more error free than tallying.

Regardless of the method used, the total of all responses to each question (except question 3) must match the total number of people asked that question. This provides a check on the accuracy of the tabulation. (Since question 3 is a multiple response question, the total number of all responses may exceed the total number of people asked that question. Questionnaires containing more than one response to question 3 should be separated from those having only one response. Tabulate and total the responses on questionnaires having only one response. Then, tabulate separately the responses for each kind of pollution mentioned on the questionnaires with more than one response. Finally, add the two tabulations together to obtain the total number of responses for each kind of pollution included in question 3.)

For purposes of odor problem identification, it is not necessary to tabulate the responses to all questions. Question 1 is included in the survey to avoid errors caused by the use of street address telephone directories that may be as much as six months old. (Such directories are usually published at six-month intervals.) Questions 2 and 3 are included for introductory purposes. Questions 4 through 10 provide odor problem definition. Question 11 permits possible identification of the odor source. Questions 12 and 13 are included so that employees of the source under investigation may be removed from the sample.

All questions may be tabulated and will yield useful information, but for odor problem identification, tabulation should begin with question 9. The responses to question 9 alone will indicate whether an odor problem exists. If it is determined that an odor problem does not exist, complete tabulation of all questions need not be undertaken.

PROBLEM IDENTIFICATION

The decisive step in odor problem identification is to determine whether a significant difference exists between the proportion of respondents in the test area who state they have been bothered by odors and the proportion of respondents in the control area who state they have been bothered by odors. This is done by using the tabulated results of question 9 from the test area and control area surveys. A form entitled "Odor Problem Identification" is included at the end of this procedure to provide a convenient method for determining whether a significant difference exists. A technical explanation of the method is presented in the "Statistical Reference" section of this procedure.

If, after completing the "Odor Problem Identification" form, the number in the box labeled "z" is equal to or larger than 1.65, a significant difference exists between the test and control areas. If "z" is less than 1.65, no significant difference exists. If this analysis indicates no significant difference, then it should be concluded that the test area is not an odor problem area. If a significant difference is indicated, then an odor problem index number should be calculated to indicate the extent of the odor problem relative to other odor problems identified within the jurisdiction of the local agency. The odor problem index number may be simply constructed by completing a form entitled "Determination of the Odor Problem Index." This form is also included below. It is based on a formula given in the "Statistical Reference" section.

It is important not to confuse the value of "z" with the odor problem index number. The value of "z" depends upon whether or not annoyance exists in relation to the number of interviews completed in the test area and the control area. As such, it is used merely to decide whether or not a community odor problem exists. The odor problem index number, however, takes into account the extent to which odors have caused bother in each area and, therefore, is used properly for comparative purposes.

ALTERNATE MEANS OF PROBLEM IDENTIFICATION

An alternate means of odor problem identification — called sequential analysis — is available to agencies that have conducted several public attitude surveys in accordance with the above instructions. It involves combining the results obtained from surveys conducted in at least three control areas, selecting a sequential sampling plan, and comparing the results obtained in future test area surveys with the plan selected. It should be considered for use particularly in cases where the existence of an odor problem is very likely.

Combining Control Area Results

The results obtained from public attitude surveys of at least three control areas that were conducted within the agency's jurisdiction during the past twelve months should be combined. This is done by simply dividing the total number of "Yes" responses to question 9 obtained from these areas by the total number of interviews completed in these areas. The average thus calculated is called the "acceptable odor level (AOL)."

Selecting a Sequential Sampling Plan

It is estimated that the AOL for almost all jurisdictions will fall between 0.100 and 0.300. For the convenience of local agencies, five sequential sampling plans are given in Tables 4, 5, 6, 7, and 8. These plans are for use in jurisdictions in which the AOL is determined to be 0.100, 0.150, 0.200, 0.250, or 0.300. They may be used in other jurisdictions as described below. However, more precise plans can be developed for these other jurisdictions as explained in the "Statistical Reference" section.

Once an AOL has been calculated for a jurisdiction, only one sequential sampling plan is appropriate for use in that jurisdiction. It may be considered to remain appropriate until such time that the agency feels a noticeable change in ambient odor intensities has occurred throughout the jurisdiction.

If the AOL differs from the above five, the sequential sampling plan with the next largest AOL should be selected. For example, if an AOL of 0.118 is calculated, the plan with an AOL of 0.150 should be selected. If an AOL larger than 0.300 is calculated, sequential analysis should not be used. The effect of using a plan with the next largest AOL would be equivalent to requiring a "z" value slightly larger than 1.65 for a community odor problem to be identified.

Table 4. Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.100, OPL = 0.263, α = 0.05, β = 0.05).

Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	31	2	8
2	*	*	32	2	9
3	*	*	33	3	9
4	*	4	34	3	9
5	*	4	35	3	9
6	*	4	36	3	9
7	*	4	37	3	9
8	*	4	38	3	10
9	*	5	39	4	10
10	*	5	40	4	10
11	*	5	41	4	10
12	*	5	42	4	10
13	*	5	43	4	10
14	*	5	44	5	11
15	0	6	45	5	11
16	0	6	46	5	11
17	0	6	47	5	11
18	0	6	48	5	11
19	0	6	49	5	11
20	0	6	50	6	12
21	1	7	51	6	12
22	1	7	52	6	12
23	1	7	53	6	12
24	1	7	54	6	12
25	1	7	55	6	12
26	1	7	56	7	13
27	2	8	57	7	13
28	2	8	58	7	13
29	2	8	59	7	13
30	2	8	60	7	13

* A no-odor-problem decision cannot be reached until 15 interviews have been completed; an odor-problem decision cannot be reached until 4 interviews have been completed.

Table 5. Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.150, OPL = 0.333, α = 0.05, β = 0.05).

Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	31	4	11
2	*	*	32	4	11
3	*	*	33	4	11
4	*	4	34	5	11
5	*	4	35	5	11
6	*	5	36	5	12
7	*	5	37	5	12
8	*	5	38	6	12
9	*	5	39	6	12
10	*	6	40	6	13
11	*	6	41	6	13
12	*	6	42	6	13
13	0	6	43	7	13
14	0	7	44	7	14
15	0	7	45	7	14
16	0	7	46	7	14
17	1	7	47	8	14
18	1	8	48	8	15
19	1	8	49	8	15
20	1	8	50	8	15
21	2	8	51	9	15
22	2	8	52	9	15
23	2	9	53	9	16
24	2	9	54	9	16
25	2	9	55	9	16
26	3	9	56	10	16
27	3	10	57	10	17
28	3	10	58	10	17
29	3	10	59	10	17
30	4	10	60	11	17

* A no-odor-problem decision cannot be reached until 13 interviews have been completed; an odor-problem decision cannot be reached until 4 interviews have been completed.

Table 6. Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.200, OPL = 0.393, $\alpha = 0.05$, $\beta = 0.05$).

Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	31	5	13
2	*	*	32	6	13
3	*	*	33	6	13
4	*	*	34	6	13
5	*	5	35	7	14
6	*	5	36	7	14
7	*	6	37	7	14
8	*	6	38	7	15
9	*	6	39	8	15
10	*	6	40	8	15
11	0	7	41	8	15
12	0	7	42	9	16
13	0	7	43	9	16
14	0	8	44	9	16
15	1	8	45	9	17
16	1	8	46	10	17
17	1	9	47	10	17
18	2	9	48	10	18
19	2	9	49	11	18
20	2	9	50	11	18
21	2	10	51	11	18
22	3	10	52	11	19
23	3	10	53	12	19
24	3	11	54	12	19
25	4	11	55	12	20
26	4	11	56	13	20
27	4	11	57	13	20
28	5	12	58	13	20
29	5	12	59	14	21
30	5	12	60	14	21

* A no-odor-problem decision cannot be reached until 11 interviews have been completed; an odor-problem decision cannot be reached until 5 interviews have been completed.

Table 7. Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.250, OPL = 0.453, $\alpha = 0.05$, $\beta = 0.05$).

Sample Size	No Odor Problem Decision No.	No Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	31	7	14
2	*	*	32	7	15
3	*	*	33	8	15
4	*	*	34	8	16
5	*	5	35	8	16
6	*	6	36	9	16
7	*	6	37	9	17
8	*	7	38	9	17
9	*	7	39	10	17
10	0	7	40	10	18
11	0	8	41	10	18
12	0	8	42	11	18
13	1	8	43	11	19
14	1	9	44	12	19
15	1	9	45	12	19
16	2	9	46	12	20
17	2	10	47	13	20
18	3	10	48	13	20
19	3	10	49	13	21
20	3	11	50	14	21
21	4	11	51	14	21
22	4	11	52	14	22
23	4	12	53	15	22
24	5	12	54	15	22
25	5	12	55	15	23
26	5	13	56	16	23
27	6	13	57	16	24
28	6	13	58	16	24
29	6	14	59	17	24
30	7	14	60	17	25

* A no-odor-problem decision cannot be reached until 10 interviews have been completed; an odor-problem decision cannot be reached until 5 interviews have been completed.

Table 8. Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed (AOL = 0.300, OPL = 0.510, $\alpha = 0.05$, $\beta = 0.05$).

Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	31	9	16
2	*	*	32	9	17
3	*	*	33	10	17
4	*	*	34	10	18
5	*	*	35	10	18
6	*	6	36	11	18
7	*	7	37	11	19
8	*	7	38	12	19
9	0	7	39	12	20
10	0	8	40	12	20
11	1	8	41	13	20
12	1	9	42	13	21
13	1	9	43	14	21
14	2	9	44	14	22
15	2	10	45	14	22
16	3	10	46	15	22
17	3	11	47	15	23
18	3	11	48	16	23
19	4	11	49	16	24
20	4	12	50	16	24
21	5	12	51	17	24
22	5	13	52	17	25
23	5	13	53	18	25
24	6	14	54	18	26
25	6	14	55	18	26
26	7	14	56	19	26
27	7	15	57	19	27
28	7	15	58	20	27
29	8	16	59	20	28
30	8	16	60	20	28

* A no-odor-problem decision cannot be reached until 9 interviews have been completed; an odor-problem decision cannot be reached until 6 interviews have been completed.

Comparing Results From Test Area Surveys With the Plan Selected

Once a sequential sampling plan has been selected by a local agency, the results obtained from future test area surveys should be compared to the plan, not to results obtained from control area surveys. In fact, except when a decision cannot be reached by using the plan or until such time that the agency feels that a noticeable change in ambient odor intensities has occurred throughout the jurisdiction, additional control area surveys should not be conducted.

The results obtained from a test area survey are compared to the plan selected by the agency as follows. Interviews are conducted with residents of the test area in the order in which their telephone numbers were randomly selected. At the end of each completed interview, the number of completed interviews and the responses to question 9 are tallied by the interviewer. The cumulative number of "Yes" responses should be kept separate from the cumulative number of "No" and "Don't know" responses. Reference is then made to the plan selected.

The cumulative number of completed interviews is shown as the "Sample Size." A comparison is made by simply finding the cumulative number of completed interviews in the "Sample Size" column and then noting the "No Odor Problem" and "Odor Problem" decision numbers corresponding to the cumulative number of completed interviews. If the cumulative number of "Yes" responses to question 9 is equal to the "No Odor Problem Decision No.," no odor problem exists in the test area. (Such a finding means that there is no significant difference between the results of the test area survey being conducted and the combined results of the control area surveys that were used in calculating the AOL.) If the cumulative number of "Yes" responses to question 9 is equal to the "Odor Problem Decision No.," an odor problem exists in the test area. (Such a finding means that there is a significant difference between the results of the test area survey being conducted and the combined results of the control area surveys that were used in calculating the AOL.)

Once either of these decisions has been made, the survey should not be continued. If, however, the cumulative number of "Yes" responses to question 9 is greater than the "No Odor Problem Decision No.," but less than the "Odor Problem Decision No.," an additional interview must be completed. The responses to question 9 are again tallied and the cumulative numbers of completed interviews and "Yes" responses are again compared to the plan selected.

For example, assume that the plan with an AOL of 0.150 is selected (see Table 5) and that a test area has been established to investigate a possible odor problem. Further assume that after completing interviews with four residents of the test area, the cumulative number of "Yes" responses to question 9 is also four. By reference to Table 5, this is sufficient for an odor problem to be said to exist. (For a "Sample Size" of 4, the "Odor Problem Decision No." is 4.) As a second example, assume that after completing interviews with 13 residents of the test area, none of the respondents stated that they were bothered by odors. Under the same sequential sampling plan, the decision is that no odor problem exists. (For a "Sample Size" of 13, the "No Odor Problem Decision No." is 0.)

As a final example, assume that after completing interviews with four residents of the test area only three of the respondents were bothered by odors. By reference to Table 5, a decision cannot be reached. Consequently, an additional interview must be completed, the responses to question 9 again tallied, and the cumulative numbers of completed interviews and "Yes" responses again compared to the plan selected. If a decision cannot be reached after 60 interviews have been completed or after the entire sample of telephone numbers in the test area has been exhausted and all no-answers and busy signals have been called a second time, a matching control area should be established. A random sample of telephone numbers should be drawn and a public attitude survey should be conducted in this control area within three days following the survey conducted in the test area. In such a case, whether or not an odor problem exists in the test area is decided by completing the "Odor Problem Identification" form.

Considerable time and expense can be saved through the use of sequential analysis in most cases. However, it should be remembered that this alternate means of problem identification does not provide an indication of the extent of an odor problem relative to other odor problems identified within the jurisdiction of the local agency.

OTHER USES OF SURVEY RESULTS

During abatement proceedings, it may be necessary to refer to the results of the test area survey to indicate the percentage of test area residents who responded in a particular way. For example, it may be necessary to state the percentage of all test area residents who noticed odors in their neighborhood during the week of the survey. It would be inaccurate, however, to use directly the percentage of test area residents who answered "This week" to question 8. An adjustment is required to eliminate responses to question 8 that are actually based on variables other than odors.

The adjustment is easy to accomplish. Simply subtract the percentage response to the question in the control area from the percentage response in the test area. The answer is then divided by one hundred percent minus the percentage response in the control area. The resulting percentage is the true percentage response for the test area. Thus, if 65 percent of test area residents and 25 percent of control area residents stated they noticed odors in their neighborhoods "This week," then 53 percent would represent the true percentage of test area residents who noticed odors in their neighborhood during the week of the survey (65% - 25%/(100% - 25%) = 53%).

PUBLIC ATTITUDE SURVEY OF COMMUNITY ODOR PROBLEMS
PROBLEM IDENTIFICATION QUESTIONNAIRE

Respondent:

Phone No. ____________________ File No. ______

Street Address ____________________ Survey No. ______

City ____________________ Respondent No. ______

Record of Call:

Date	Time	Check If Interview Completed	Check If Interview Not Completed	Reason If Not Completed
______	______	( )	( )	______

"Hello. My name is ______(name)______. I'm calling (long distance) for a government agency interested in certain community problems. I'd like to talk with the man/lady of the house to get his/her opinion on a few questions. Are you the man/lady of the house?" (IF NOT, ASK: "May I talk with him/her?")

Q1) Have you lived at your present address more than six months?

____1. Yes

____2. No (SAY: "I'm sorry. This survey was designed for longer term residents. Thank you for your time.")

1______

Q2) Lately, people have become very much concerned about the environment and various types of pollution. Do people complain about any kind of pollution in your neighborhood?

____1. Yes (ASK Q3.)

____2. No (ASK Q4.)

____3. Don't know (ASK Q4.)

2______

Q3) Do people complain about...?

____1. Air pollution in your neighborhood

____2. Water pollution in your neighborhood

____3. Airport, industrial, or traffic noise in your neighborhood 3____

____4. Noticeable odors in your neighborhood

____5. Don't know (DO NOT READ THIS RESPONSE.)

Q4) Have you noticed any odors in your neighborhood in the last three months?

____1. Yes (ASK Q5.)

____2. No (SKIP TO Q12.) 4____

____3. Don't know (SKIP TO Q12.)

Q5) How often have you noticed these odors?

____1. At least once a day

____2. At least once a week, but not every day

____3. At least once a month, but not every week 5____

____4. Less than once a month

____5. Don't know

Q6) Generally speaking, how long do these odors last?

____1. At least one day

____2. At least one hour, but less than one day

____3. At least 15 minutes, but less than one hour 6____

____4. Less than 15 minutes

____5. Don't know

Q7) How strong would you say these odors smell? Would you say...?

____1. Very strong

____2. Strong

____3. Moderate

____4. Slight

____5. Don't know (DO NOT READ THIS RESPONSE.)

7____

Q8) When was the last time you noticed odors in your neighborhood?

____1. This week

____2. Last week

____3. Two to four weeks ago/a month ago

____4. More than a month ago

____5. Don't know

8____

Q9) Would you say that these odors have bothered you?

____1. Yes (ASK Q10.)

____2. No (SKIP TO Q11.)

____3. Don't know (SKIP TO Q11.)

9____

Q10) How much would you say they have bothered you? Would you say...?

____1. Very much

____2. Much

____3. Moderately

____4. Little

____5. Don't know (DO NOT READ THIS RESPONSE.)

10____

Q11) Where would you say most of these odors originate, that is, who or what causes them?

____1. Source(s) being investigated

____2. Other source(s): ________________________________

____

____3. Don't know

11_____

"All this information is strictly confidential, but we need it for statistical purposes."

Q12) What company do you work for?

____1. Source(s) being investigated

____2. Other company/none: ____________________________

____

____3. Refused

12_____

Q13) What companies do other members of your household work for?

____1. Source(s) being investigated

____2. Other company(ies)/none: _________________________

____

____3. Refused

13_____

"That completes the interview. Thank you very much for your time."

Interviewer's Name: ____

PUBLIC ATTITUDE SURVEY - TABULATION FORM

File No. ______
Survey No. ______

Instructions. Place a tally mark in the appropriate box to record the answer to each completed question on the questionnaire. By tallying the fifth duplicate response with a diagonal line, counting total responses is simplified (卌 = 5 responses).

Question 1. (Tabulate only if desired)		
Response 1	Response 2	
Total Response 1	Total Response 2	Total

Question 2. (Tabulate only if desired)			
Response 1	Response 2	Response 3	
Total Response 1	Total Response 2	Total Response 3	Total

Question 3. (Tally all responses given on each questionnaire, if desired)					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 4.			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

Question 5.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

PUBLIC ATTITUDE SURVEY - TABULATION FORM (Continued)

File No. ______
Survey No. ______

Question 6.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 7.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 8.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 9.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 10.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

PUBLIC ATTITUDE SURVEY - TABULATION FORM (Continued)

File No. ______
Survey No. ______

Question 11. (Tabulate only if desired)			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

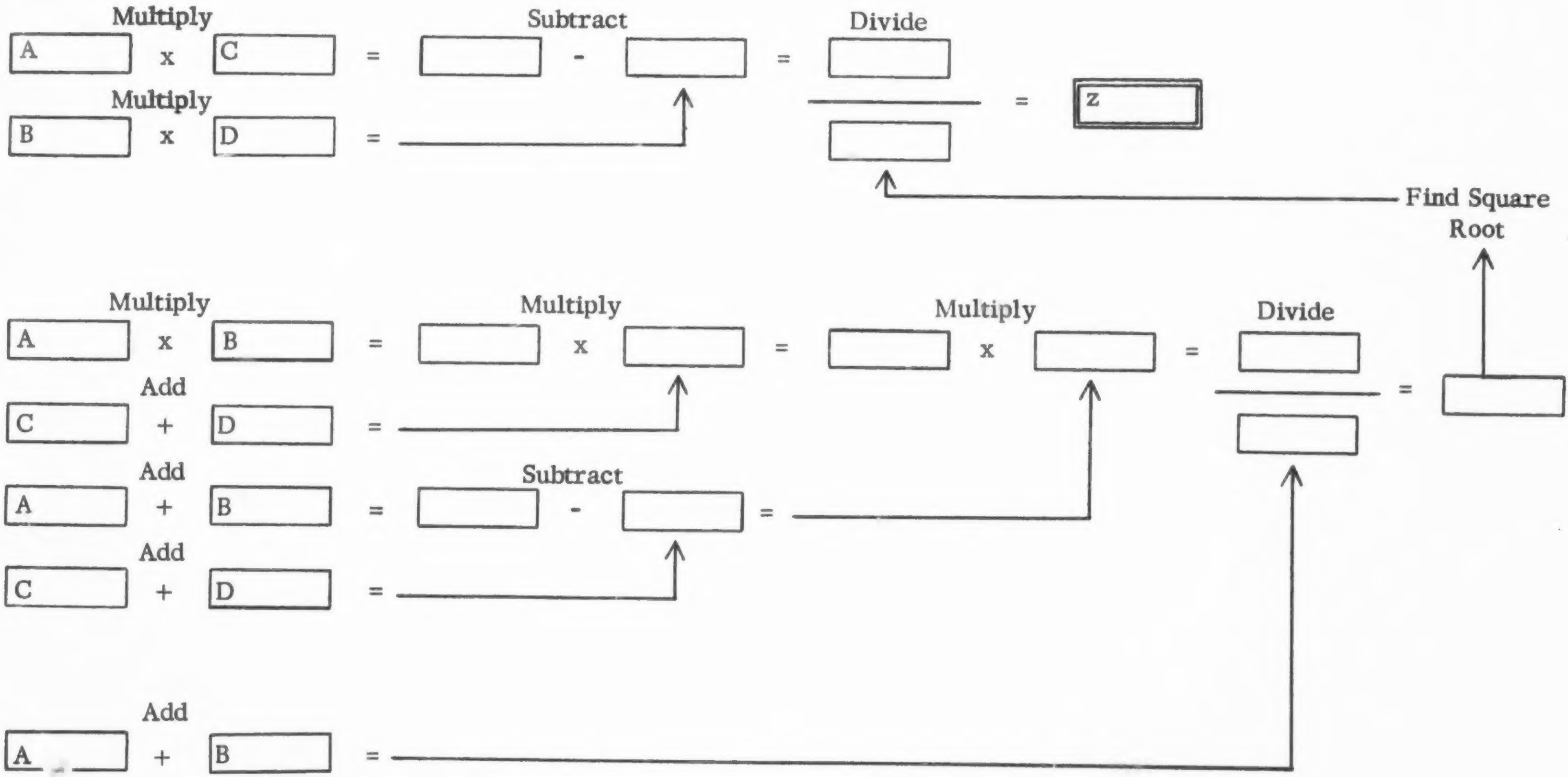
Question 12. (Tabulate only if desired)			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

Question 13. (Tabulate only if desired)			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

ODOR PROBLEM IDENTIFICATION

Instructions

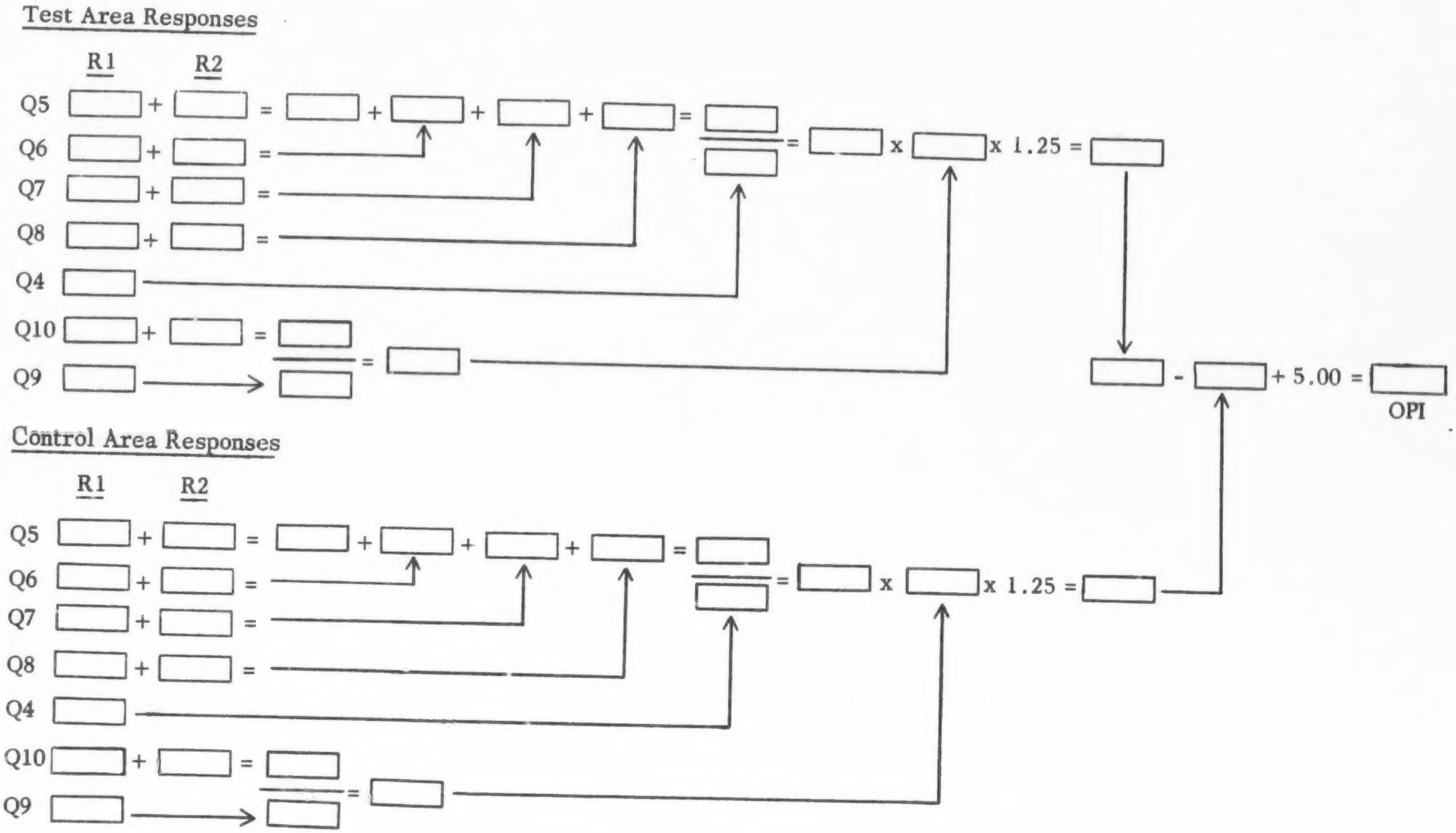
1. In each box labeled "A," fill in the number of interviews completed in the Control Area survey. (The number of interviews completed = the number of problem identification questionnaires checked as completed.)
2. In each box labeled "B," fill in the number of interviews completed in the Test Area survey.
3. In each box labeled "C," fill in the number of "Yes" responses (R 1) to Question 9 from the Test Area survey.
4. In each box labeled "D," fill in the number of "Yes" responses (R 1) to Question 9 from the Control Area survey.
5. Follow the direction of the arrows. Perform the calculations indicated. (The square root can be easily found by referring to a standard table of square roots and, therefore, need not be calculated.)
6. If the number in the box labeled "z" is 1.65 or more, an odor problem exists.



DETERMINATION OF THE ODOR PROBLEM INDEX

Instructions

Insert the total numbers of responses tabulated from the surveys in the boxes provided. Follow the direction of the arrows. Perform the calculations indicated.



STATISTICAL REFERENCE SECTION

Statistically Significant Differences for Odor Problem Identification

To determine whether there is a significant difference between the test and control area responses to question 9 of the Problem Identification Questionnaire, the following hypotheses must be tested:

Hypothesis 1 (H_1): $\pi_t = \pi_c$

Hypothesis 2 (H_2): $\pi_t > \pi_c$ (one-tail test)

$\alpha = 0.05$

where:

π_t = the true or universe proportion of "Yes" responses to question 9 in the test area

π_c = the true or universe proportion of "Yes" responses to question 9 in the control area

α = the probability of concluding, on the basis of sample values, that no significant difference exists between test and control areas when a significant difference in universe values exists

Using the normal approximation:

$$(1) \quad z = \frac{(P_t - P_c) - (\pi_t - \pi_c)}{\sqrt{\frac{\pi_t(1 - \pi_t)}{n_t} + \frac{\pi_c(1 - \pi_c)}{n_c}}}$$

where:

n_t = the sample size, i.e., the number of interviews completed in the test area

n_c = the sample size, i.e., the number of interviews completed in the control area

k_t = the number of "Yes" responses to question 9 in the test area

k_c = the number of "Yes" responses to question 9 in the control area

$$p_t = \frac{k_t}{n_t}$$

$$p_c = \frac{k_c}{n_c}$$

Assuming the null hypothesis (H_1) is true, this equation becomes:

$$(2) \quad z = \frac{p_t - p_c}{\sqrt{\hat{\pi}(1 - \hat{\pi})\left(\frac{1}{n_t} + \frac{1}{n_c}\right)}}$$

Estimating π by $\hat{\pi} = \frac{k_t + k_c}{n_t + n_c}$

and setting $N = n_t + n_c$

and $K = k_t + k_c$

then (2) can be rewritten as:

$$z = \frac{\frac{k_t}{n_t} - \frac{k_c}{n_c}}{\sqrt{\frac{K(N - K)}{N n_t n_c}}} = \frac{n_c k_t - n_t k_c}{\sqrt{\frac{n_t n_c K(N - K)}{N}}}$$

If z is normal, then the probability of $z \geq 1.65 = 4.95\%$ or approximately 5%.

It is noted that, in cases where sample size n_t (or n_c) is a large fraction of the total number of telephones in the test area (or control area), the calculated value of "z" will somewhat understate any difference in π_t and π_c. In such cases, marginally significant differences between π_t and π_c may not be indicated by the calculated value of "z" and, consequently, marginally existent community odor problems may not be identified. To preclude this possibility, the value obtained from using the "Odor Problem Identification" form should be multiplied by one of the following correction factors. If the resulting corrected value of "z" is equal to or larger than 1.65, a community odor problem is said to exist.

Table 9. Correction factors for use when sample size is a large fraction of the total number of telephones in the area to be surveyed.

If the number of telephones in the area is:	Multiply the value obtained from the "Odor Problem Identification" form by:
1-90	census of area, no correction factor applied
91-180	1.09
181-270	1.06
271-360	1.04
361-450	1.03
451-540	1.03
541-630	1.02
631-720	1.02
721-810	1.02
811-900	1.02
901-990	1.02
991-1080	1.01
1081-1170	1.01
1171-1260	1.01
1261-1350	1.01
1351 and over	<1% error if no correction factor applied

Determination of the Odor Problem Index

$$\text{OPI} = 1.25 \left[\frac{(R1 + R2)_{Q5} + (R1 + R2)_{Q6} + (R1 + R2)_{Q7} + (R1 + R2)_{Q8}}{(R1)_{Q4}} \cdot \frac{(R1 + R2)_{Q10}}{(R1)_{Q9}} \right] \text{Test Area}$$

$$- 1.25 \left[\frac{(R1 + R2)_{Q5} + (R1 + R2)_{Q6} + (R1 + R2)_{Q7} + (R1 + R2)_{Q8}}{(R1)_{Q4}} \cdot \frac{(R1 + R2)_{Q10}}{(R1)_{Q9}} \right] \text{Control Area}$$

$$+ 5.00$$

where: OPI = Odor Problem Index

R1 = response 1; R2 = response 2; etc.

Q1 = question 1; Q2 = question 2; etc.

The above formula is based on the Problem Identification Questionnaire. Assuming that the control area is as odor free as possible (at least as free of odors as the test area), the formula will yield an index number between zero and 10. The size of this number depends upon the combination of frequency (Q5), duration (Q6), intensity (Q7), and recentness (Q8) of odors noticed in the test area as compared to the control area. This combination of problem-inducing variables is weighted by the extent to which odors have caused bother in each area.

Development of a Sequential Sampling Plan

The first step in the development of a sequential sampling plan involves the calculation of an acceptable odor level (AOL) as described in the procedure. The second step requires the calculation of an odor problem level (OPL) — by trial and error. To accomplish the latter step, use the "Odor Problem Identification" form to find the number of "Yes" responses to question 9 from a test area survey (the boxes labeled "C") that would have had to be obtained for "z" to equal 1.65. Fill in the boxes labeled "D" with the number that results from multiplying the AOL by 30. Fill in the boxes labeled "A" and "B" with the number 30. The OPL is calculated by dividing the number found for the boxes labeled "C" by 30.

The third step requires the calculation of h_1, h_2, and s, where:

$$h_1 = \log \frac{1-\alpha}{\beta} / \log \frac{OPL\ (1-AOL)}{AOL\ (1-OPL)}$$

$$h_2 = \log \frac{1-\beta}{\alpha} / \log \frac{OPL\ (1-AOL)}{AOL\ (1-OPL)}$$

$$s = \log \frac{1-AOL}{1-OPL} / \log \frac{OPL\ (1-AOL)}{AOL\ (1-OPL)}$$

α = the probability that an odor problem decision will be reached when no odor problem exists = 0.05

β = the probability that a no odor problem decision will be reached when an odor problem exists = 0.05

AOL = an acceptable odor level

OPL = an odor problem level

Generation of the series of decision numbers from which the plan is developed is accomplished by calculating c_1 and c_2 for n equal to 1 through 60, where:

c_1 = a no odor problem decision number = $-h_1 + sn$

c_2 = an odor problem decision number = $h_2 + sn$

n = the sample size

In general, c represents the number of respondents in the community being surveyed who stated they have been bothered by odors. Thus, the series of decision numbers generated above must be rounded to equal zero or whole numbers according to the following rules:

- For c_1, any fraction of a whole number should be rounded to the next lowest whole number. Negative numbers in the series should be ignored.

- For c_2, any fraction of a whole number should be rounded to the next highest whole number. Negative numbers should not be encountered.

As a final step, the series of rounded decision numbers should be put into a tabular form similar to those of Tables 4 through 8 of the procedure. It is noted that a sequential sampling plan developed in this manner will provide the same decision as $z = 1.65$ only when n equals 30 completed interviews. At less than 30 completed interviews, decisions under such a plan would be comparable to $z > 1.65$ (the decisions, therefore, being made with somewhat greater confidence). At greater than 30 completed interviews, decisions under such a plan would be comparable to $z < 1.65$ (the decisions, therefore, being made with somewhat less confidence).

Adjustment to Eliminate Test Area Responses Based on Variables Other Than Odors

The formula is a Bayesian type of correction for chance success:

$$P'(S\ s) = \frac{P(S|s) - P(S|n)}{100 - P(S|n)}$$

where: $P'(S|s)$ = the percentage of "signal" attributable to the variable under study

$P(S|s)$ = the total percentage of "noise" plus "signal" measured in the test group

$P(S|n)$ = the percentage of "noise" measured in the control group

PROCEDURE FOR SOURCE VERIFICATION BASED ON SENSORY TECHNIQUES

INTRODUCTION

This procedure is designed to assist local agencies in source verification of identified odor problems. It describes the proper use of two sensory techniques — one using a Barnebey-Cheney Model I-3 Scentometer, the other employing an odor judgment panel trained to evaluate an odorized environment in terms of memorized reference standards. As implied below, the choice of techniques for use in a particular case depends upon the extent of information desired.

An odor judgment panel can be used to obtain extensive information about the quality and areal extent of odors as they vary with time. This information enables verification of specific sources of odors and provides detailed documentation of chronic situations in test areas. The size of an odor panel depends on the size of a test area. In most cases, one panelist per city block is essential to provide adequate coverage. Therefore, a considerable number of panelists are required if the test area is large.

A scentometer can be used to measure the intensity of ambient odors in relation to the four ranges of dilution to threshold. To determine the correct range requires a minimum time period of about one minute. When odors are strong and constant, scentometers can be used to obtain information similar to odor judgment panels, but when low intensity and transient odors are encountered, the scentometer is more applicable for measuring maximum, rather than average, intensities. With strong and constant odors, one scentometer may be adequate to cover a square mile or more, but with low intensity and transient odors, one scentometer may be adequate to cover only a few city blocks.

WHEN TO USE THE SCENTOMETER

The scentometer is best suited for use in routine surveillance of chronic situations. It should be used to determine if odors can be detected at or above 7 dilutions to threshold and, thereby, to indicate the locations of possible odor problems.

The scentometer can be used to assist a trained observer to verify the source of an identified odor problem. Specifically, it can be used:

(1) To provide a measure of odor intensity at a particular location at a particular time.

(2) To establish a pattern of peak odor intensities while systematically traversing the test area in an automobile, which, when combined with a consideration of the existing meteorological conditions, may pinpoint the source of the odor.

The scentometer can also serve as an odor free air chamber to refresh the trained observer whose ability to continuously sense the odor under investigation may otherwise be lessened due to fatigue.

WHEN TO USE AN ODOR JUDGMENT PANEL

An odor judgment panel should be used to verify the source of an identified odor problem if such verification cannot be established by a trained observer alone or by a trained observer using a scentometer or equivalent dilution device. For source verification, an odor judgment panel can be used:

(1) To establish patterns of mean odor intensities and percentages of time odor was detected from concurrent evaluations at points throughout the test area.

(2) To judge the odor under investigation when odors of different qualities are encountered in the test area.

Such uses are possible only after lengthy selection and training processes necessary to ensure that the panelists can accurately relate to the quality and range of intensities expected to be encountered in the test area.

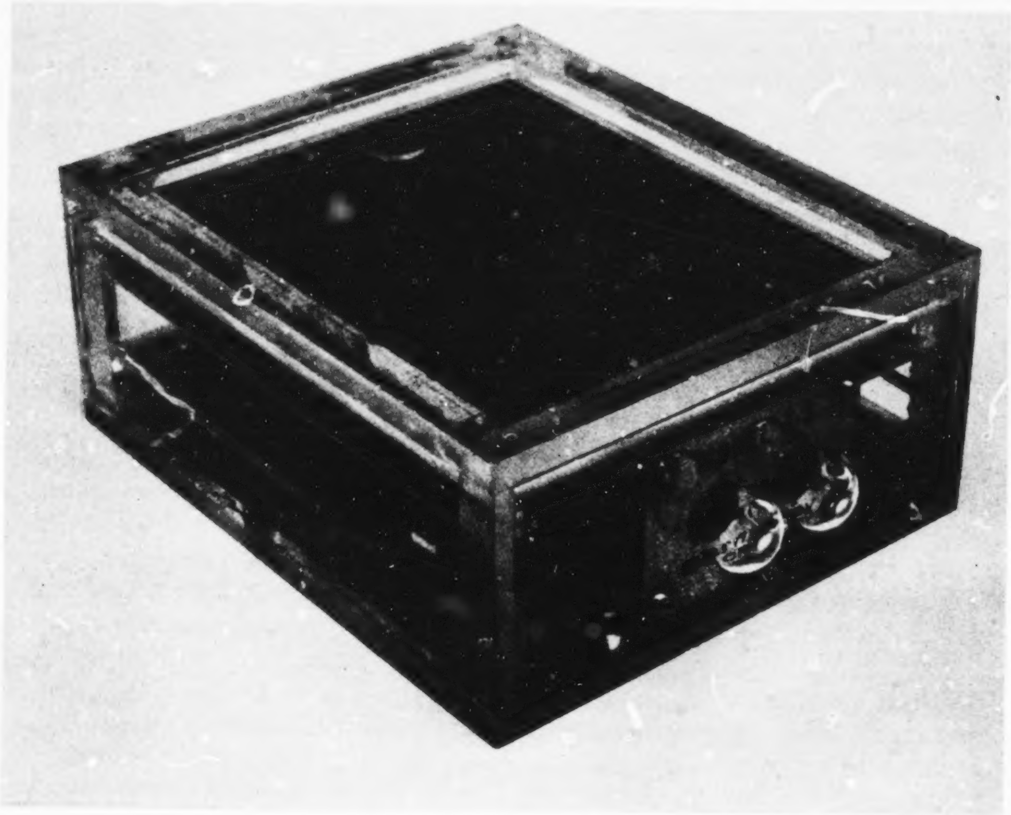
THE SCENTOMETER

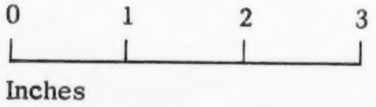
The scentometer (Figure 2) has been described in the literature and used by at least twelve local air quality agencies throughout the United States. Most of the descriptions have focused on the physical characteristics of the device and the principles of operation. Emphasis in this procedure is based on experience gained from actual use.

Preparation for Field Use

Before going into the field, the scentometer should be checked for proper function as follows: Tapes must be placed over the four dilution orifices in such a way that they can be pulled clear of the orifices and replaced repeatedly. It should be determined that odors are effectively absorbed by the charcoal beds. If necessary, fresh charcoal should be installed. Before each use, the scentometer should be shaken gently in a horizontal position to distribute the charcoal evenly over the beds, thereby eliminating the possibility of channeling.

Figure 2. Barnebey-Cheney, Model I-3 Scentometer.





The scentometer must be examined for leakage, especially around the two bulbs which fit to the operator's nostrils. If the bulbs are applied with pressure to the nostrils to avoid leakage, soreness can develop during constant use in the field. If the bulbs are placed gently against the nostrils, leakage can result. Before and during measurements, the operator should check that no leakage of any type is occurring. This is done by using the scentometer in an area of strong odor after blocking the four orifices. No odor should be discernible.

Field Measurements

Before field measurements are attempted, the scentometer operator must first neutralize the effects of ambient odors by inhaling odorless air through the charcoal beds of the scentometer while keeping the four orifices blocked. When this is accomplished, he should open the orifices of the scentometer in turn until he can identify the smallest orifice through which odor can be detected.

It is noted that, while this technique is generally successful with strong and constant odors, very few readings may be obtained with low intensity and transient odors. Under the latter conditions, it is advantageous to use the scentometer while driving through a community. The application of this technique by a mobile operator is fairly simple and considerably more effective.

If odor is encountered in a community during routine surveillance, the intensity should be measured with the scentometer. Intensities detected at or above 7 dilutions to threshold would indicate the location of a possible odor problem. Before attempting measurements, the operator should relax and breathe odor free air. This can be done by using the scentometer as an odor free chamber. However, it is more desirable to drive outside the affected area, since it is difficult for the operator to relax with the scentometer bulbs pressed against the nostrils.

When the operator is suitably refreshed, the car is driven through the affected area. Throughout this drive the operator breathes through the scentometer with a selected orifice open. The route then may be retraced with a different orifice uncovered in order to further define the odor intensity. Each time the route is traversed, the operator calls out the points at which negative readings change to positive and vice versa. These points should be plotted on a map of the area or recorded on a form such as the "Scentometer Log Sheet" provided at the end of this procedure. It is possible to have four operators and a driver traverse the area in one car. With a different orifice open on each scentometer, a reading for any odor in the area can be quickly obtained.

This method, while more effective than scentometer readings taken at a fixed point, entails some problems. The automobile must be well ventilated and maneuverable. There must be two to five people in each car. If there are less than five people in a car, the success of the technique depends upon the constancy of the odor, since two or more trips through the area would be required to obtain readings through all of the orifices.

During times when scentometer measurements are performed for prolonged periods, some operators have reported discomfort to their nostrils or have experienced difficulty in continually drawing air through the scentometer by action of their lungs. To avoid this, a small air pump can be used to draw the required dilution of ambient air through the scentometer, thereby distributing the diluted sample under positive pressure through a face mask to the operator. The most satisfactory system appears to be dependent solely on the individual operator's preference.

THE ODOR JUDGMENT PANEL

If a local agency wishes to perform odor judgment panel evaluations, panel members could be recruited from among the agency employees. This approach could reduce the urgency of preliminary activities and lower costs considerably, since panelist selection and training could be conducted at leisure at the agency facilities. It must be considered, however, that the results of evaluations by agency employees could be criticized as being biased against the source under investigation.

Regardless of this possibility, certain preliminary activities must be undertaken each time an odor judgment panel is to be used. These activities include determination of the size of the panel required, location of suitable stations (points in the test area at which panelists would be placed), location of a panel headquarters (if the agency facilities cannot be used), and preparation for transporting the panelists between the headquarters and the test area.

Preliminary Activities

The community in which an odor judgment panel is to be used should be visited to determine the areal extent of the odor to be investigated. It should be initially planned to provide one panelist for each city block affected by the odor. If the test area is very large, the size of the panel must be determined by budgetary constraints. It is recommended that a minimum of twelve panelists be used for source verification in any case where public nuisance law is applicable.

The stations should be located in a systematic manner so that panel members are roughly equally spaced, with intervening distances not exceeding one city block (approximately 100 yards). Local odor interferences such as caused by automotive service garages, bakeries, or heavily traveled roadways should be avoided when selecting stations. Large scale maps of the test area should be used to plot all stations. Such maps should be sketched if none are available from commercial or governmental sources.

In addition to selecting stations, convenient locations for performing panel calibration tests must be found. These locations must be immediately downwind from an odor source, at places where the presence of large panel groups will not cause much disturbance in the neighborhood. Public parking lots, particularly for municipal golf courses and parks, work well.

The headquarters, which is the site used for testing, screening, training, and assembling, should be located close to the test area. The shorter the distance between the locations, the less the expense and proportion of daily schedule consumed in travel. However, one problem with having a headquarters close to the site is the possibility of leakage of information to the source under investigation. Thus, depending upon secrecy requirements, it may be necessary to locate several miles away from the site. Once in the test area, the presence of an odor panel is quickly noticed not only by residents, but possibly by employees of the facilities under investigation. Thus, to minimize the number of interruptions from curious outsiders and to further reduce the possibility of leakage of information, it may be desirable to use the panel for single days only or for two or more randomly chosen days.

Transportation of the panelists to the test area can be by either cars or a bus. If a bus is used, all panelists may be transported together and only one local agency representative is required to serve as driver. However, a significant amount of maneuvering is required in this work, and buses are not readily maneuverable. Cars are more maneuverable but, as the entire panel cannot be transported in one car, additional drivers are required. Cars are preferable as long as the area is known and several drivers are available, while a bus is preferable to a convoy of cars in an unfamiliar area.

To ensure proper selection, training, and deployment of panelists, one agency representative should be assigned to work with a maximum of six panelists. If such representatives would serve as drivers, the requirement for additional drivers is easily satisfied. Nine passenger station wagons provide an ideal compromise between buses and cars. With vehicles of this capacity, six panelists and their assigned agency representative can be transported together.

Recruiting Potential Panelists

If sufficient agency employees are not available, candidates for odor panel work must be recruited from other sources. If an odor panel is required for short periods of one week or less, college students or temporarily unemployed people are usually available, but for longer periods or for continuing use at regular intervals, housewives are the most available group. It may be convenient to assign the task of recruiting potential panelists to an employment agency or professional survey firm.

Initial Selection of Panelists

After sufficient candidates have been recruited, the screening of potential panelists should be undertaken. Such screening is intended to exclude individuals with particularly insensitive or irrational responses to odors. Series of triangle tests are used initially to screen potential panelists. This method is quick, easy, and inexpensive to perform. The necessary equipment consists of a supply of 2-ounce paper cups, water, and odorous food extracts such as vanilla and wintergreen. The prospective panel members are given three cups to sniff and are instructed to specify the cup with the different odor. The three cups presented to the panelists may be one of the three following combinations:

(1) Two with the same odor, one with a different odor.
(2) Two with water (no odor), one with an odor.
(3) Two with the same odor, one with water (no odor).

It is best to begin this test using strongly scented samples detectable to everyone. The concentration of extract should be gradually decreased in water toward threshold levels. If the tests are conducted over several hours, breaks should be taken at regular intervals to avoid sensory fatigue. The test room should be well ventilated and odor free. Use of an activated carbon room purifier unit, such as the Barnebey-Cheney Model ABB (4,000 cfm) or Model ADB (10,000 cfm), may be necessary to ensure an absence of ambient odors.

After each test involving all panelists, the scores should be reviewed to ascertain the percentage of correct answers. A range of correct answers should be chosen as a target, say 50% to 75%. If, for most prospective panelists, the actual percentage is outside this range, the concentration of odorants must be readjusted. When 6 to 9 tests within the chosen range of correct answers have been completed, potential panelists should be accepted or rejected on the basis of their scores. An acceptable range of plus and minus two correct answers from the mean of the group is recommended.

Final Selection of Panelists

After the preliminary screening by triangle testing, training with reference standards is begun. A stable, non-toxic standard(s) should be chosen that closely matches the odor(s) to be encountered in the test area. Using various concentrations of this standard, the remaining candidates (now called "panelists") are trained to recognize the strengths of the odor with which they will be concerned. Any one of a variety of standards may be utilized. In a study of solvent emissions, for example, a methyl chloroform series may be used for degreasing process odors, a turpentine series for thinner odors, or an amyl acetate series for lacquer solvent odors. A panel recruited to observe rendering plant odors can be trained with ethanolamines. For refinery odors, reference standard solutions of tertiary dodecyl mercaptan are suitable.

If the affected area is close to an industrial complex in which a number of chemical plants produce similar products, selection of stable, non-toxic reference standards for each odor quality encountered is virtually impossible. In such circumstances, standards representing each odor quality may be used for identification purposes; however, a single standard, such as 1-butanol, should be used for intensity training.

The reference standard is dissolved in varying concentrations in an odorless solvent and numbered according to strengths. The number of strengths in a series may vary from 4 to 12 depending upon the range of odor intensities expected to be encountered and the ability of the trained nose to differentiate between the strengths of adjacent solutions. As exemplified in Table 10, if the number of strengths in a series is limited to four, each solution might be four times more concentrated than the previous solution.

Table 10. Concentration of reference standard in odorless solvent used to simulate four strengths of the odor expected to be encountered in the test area.

Odor Intensity Rating	Concentration in Solvent (milliliters/liter)	Layman Assessment
1	0.125	slight
2	0.5	moderate
3	2	strong
4	8	very strong

The reference standards should be mixed ahead of time, although the undiluted odorant and solvent should be brought to the panel headquarters in case different or additional concentrations must be prepared.

Again, the test room should be well ventilated and odor free. The standards may be presented in capped, 4-ounce, polyethylene bottles with a polyethylene insert to minimize the possibility of leakage caused by shaking. Even with these bottles, however, napkins or paper towels should be kept on hand in case of spills. Dark bottles are preferred to prevent the panelists from noticing any color the diluted odorant may possess.

Panelists should be instructed to shake the bottle gently once or twice, remove the cap, and squeeze the sides once as they hold the bottle under the nose. After a period of memorizing the different strengths and a few breaks to avoid fatigue, they should be encouraged to test themselves by removing a standard from the series at random and attempting to judge its intensity. At this time, the panel instructors should circulate about the room and test the panelists with unmarked samples. Prior to the training, a few sets of standards should be prepared on which the numbers are not clearly shown but are hidden on labels attached to the bottom of the bottles. All panelists should be asked to sniff one of these samples and judge the strength of the odor. Panelists' scores should be recorded and combined with the results of field calibration tests (described below) before the panel selection is finalized.

Instructions to Panelists

When the results of the reference standard tests indicate that the panelists are ready to go into the field, briefing on recording procedure is necessary. In addition, the following points should be stressed to them:

(1) All evaluation materials, including clipboards, rating sheets, and pencils, will be supplied by the local agency.

(2) A watch with a second hand and a large, easily read face is to be worn by each panelist.

(3) Appropriate clothing, including hats, coats, and gloves, is to be worn by each panelist if unfavorable weather is to be expected. (The work involves standing on streets. Cold wind and dampness, which may be present, can affect the efficiency of the unprepared panelist.)

(4) Smoking is forbidden.

(5) Perfume and other strongly scented toiletries are not to be worn.

(6) Gum chewing and similar diversions by panelists are discouraged.

(7) The recognition of transient odors requires constant attention. Panelists must be as alert to the task as possible.

(8) Panelists must rate odors encountered in the test area in accordance with the strengths of the reference standards memorized in the test room.

All values should be recorded on an "Odor Intensity Rating Sheet," an example of which is included at the end of this procedure. How frequently values should be recorded depends upon the frequency, duration, constancy, and intensity of the odors. Normally, panelists should be asked to record the highest intensity present during each minute. The time recorded should reflect the end of each minute. For example: "Time: 10:40 a.m., Rating: 1" means that 1 was the highest intensity perceived between 10:39 a.m. and 10:40 a.m. Similarly, "Time: 3:45 p.m., Rating: 0" means that no odor was detected between 3:44 p.m. and 3:45 p.m.

Determining the "quality" of the odor perceived is often a problem, i.e., whether or not an odor encountered is that which bothers test area residents. Panelists should be instructed as follows:

(1) If the panelist is not sure whether the odor is like that used during training, he must record the odor intensity as accurately as possible and make a notation regarding odor quality.

(2) Only if the panelist is certain that the odor is foreign, i.e., if he can positively identify it as coming from some source other than that under study, should he record a zero. Even in such a case he should describe the quality of the odor perceived.

Calibration Tests

Uniformity of response among panelists must be monitored during both the training and field phases of the work. This is done by conducting field calibration tests, i.e., by having all panelists record data at one site. There should be a distance of at least two yards between panelists to ensure independent recordings. Any panelists who consistently record values significantly different from those of the majority should be rejected. Calibration tests actually serve two purposes. In addition to indicating the uniformity of the panelists' responses and, consequently, the reliability of the field values, they provide additional training and experience in the field.

Work Schedule

To get all panelists to work as a unit and, thereby, avoid those delays which result in reduced evaluation time in the test area, a rigid adherence to schedule is required. It has been observed that about one hour is the optimum time to leave a panelist on station. The panelists' concentration capabilities deteriorate significantly after working in solitude in one place for an hour. The type of schedule shown in Table 11 has been found to work well.

Panel calibration tests can be incorporated into the schedule by reducing the 1 hour and 10 minute periods allocated to panelists at individual stations. Normally, one 10 minute calibration test in the morning and another of equal duration in the afternoon is sufficient to monitor uniformity of response.

Table 11. Recommended work schedule.

Time Period	Activity	
9:30 a.m. - 9:50 a.m.	Arrival of panelists, ready for departure	
9:50 a.m. - 10:10 a.m.	Travel to site, position panelists at first stations	
10:10 a.m. - 11:20 a.m.	Panelists record at first stations	
11:20 a.m. - 11:40 a.m.	Transfer to second stations	
11:40 a.m. - 12:50 p.m.	Panelists record at second stations	
12:50 p.m. - 1:10 p.m.	Return to headquarters	
1:10 p.m. - 2:10 p.m.	Lunch, restroom, etc.	
2:10 p.m. - 2:20 p.m.	Short discussion, ready for departure	
2:20 p.m. - 2:40 p.m.	Travel to site, position panelists at first stations	
2:40 p.m. - 3:50 p.m.	Panelists record at first stations	
3:50 p.m. - 4:10 p.m.	Transfer to second stations	
4:10 p.m. - 5:20 p.m.	Panelists record at second stations	
5:20 p.m. - 5:40 p.m.	Return to headquarters	
5:40 p.m. - 5:45 p.m.	Dismissal of panelists	
	Total time evaluating odors	4-3/4 hours
	Total time working	7-1/4 hours
	Total time on break	1 hour
	Total time per day	8-1/4 hours

General Observations

Based on the results of the use of odor judgment panels during the national survey of the odor problem and the study of the social and economic impact of odors, some observations are offered for local agency consideration.

(1) Some panelists become very anxious during calibration runs, whereas they are relaxed when alone during actual field measurements.

(2) Some panelists have difficulty in concentrating if left alone for long periods and start talking to passers-by, listening to radios, etc. Some discipline is required.

(3) Panelists should be instructed to try to avoid direct questions from passers-by and, if necessary, should indicate that they are surveying cars or other objects unrelated to odors. Some are able to be convincing without difficulty, while others may have trouble.

(4) Panelists are sometimes questioned by police. It is therefore necessary to inform the local police of the field schedule before the evaluations take place.

SOURCE VERIFICATION

The data recorded by each panelist should be in the form of a series of odor intensity ratings against time, with one intensity value recorded each minute during a period of evaluation. Such information should be obtained for each station in the test area. From this, the distribution of odor over the portion of the test area covered by the odor judgment panel can be estimated by local agency personnel.

After each evaluation, the intensity values recorded by each panelist should be averaged separately. Psychologists generally prefer the use of median values as a measure of central tendency of data generated by human evaluation. But, because of the highly skewed distribution of odor intensity ratings that are typically obtained (particularly when odors are transient, many "no odor" ratings are listed), the mean values recorded at each station are recommended for source verification purposes. Thus, averaging is performed by simply adding the intensity values recorded and dividing the total by the number of observations.

In addition, the percentage of time that odor was detected by each panelist should be determined. This permits an estimation of odor distribution based on whether or not odor was perceived and depends only upon the panelists' judgment of odor quality in relation to the reference standards. The percentage is determined by counting the number of times odor was perceived, dividing the total by the number of observations, and multiplying this answer by 100.

During the preliminary activities leading to the use of an odor judgment panel, all stations should have been plotted on a map of the test area. Now, for each station the mean odor intensity should be noted on the map as in Figure 3 and the percentage of time that odor was detected should be noted on a duplicate map as in Figure 4. After this, isopleths — lines of equal mean odor intensity or equal percentage of time that odor was detected — should be constructed. By constructing such isopleths, studying recorded wind data for the periods of panel evaluation, and noting the topographical features of the test area, the odor source usually can be verified with confidence and patterns of odor distribution within the test area can be established.

During the course of an investigation of a particular test area, several odor judgment panel evaluations may be completed. (Based on the recommended work schedule, a total of four evaluations per day would be completed.) The data recorded should be summarized separately for each evaluation so that changes in odor distribution due to variations in wind, other meteorological conditions, and even source emissions can be documented. A form entitled "Odor Intensity Rating Summary Sheet" is provided at the conclusion of this procedure for the convenience of local agency personnel in preparing the summary information.

OTHER DILUTION DEVICES FOR SOURCE VERIFICATION

It is noted that dilution devices other than the scentometer have become available since the performance of the field activities that led to the development of this procedure. It is possible that these devices also can be used to obtain measurements of ambient odor intensity for purposes of source verification.

Figure 3. Example of isopleths representing mean odor intensities recorded by odor judgment panelists stationed in a test area at the points indicated.

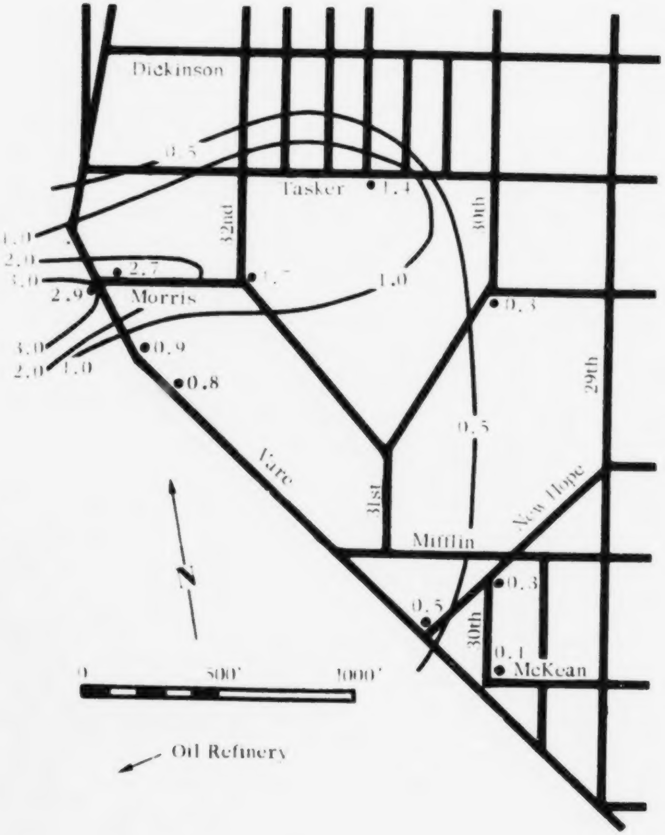
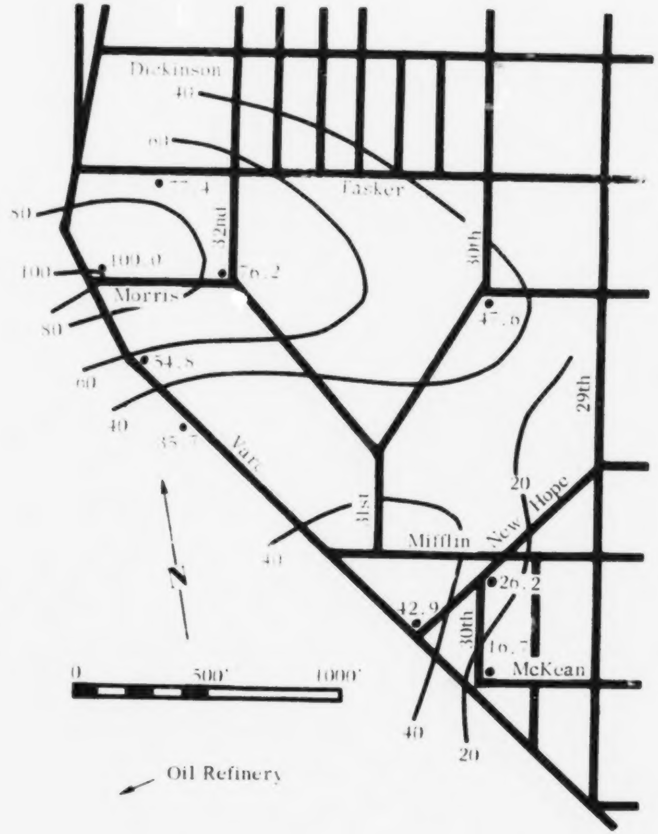


Figure 4. Example of isopleths representing percentages of time odor was detected by odor judgment panelists stationed in a test area at the points indicated.



File No. ____________

SCENTOMETER LOG SHEET

Date ____________

Community(s) Affected ____________

Odor Source(s) ____________

Operator 1 ____________

Operator 2 ____________

Operator 3 ____________

Operator 4 ____________

Points at Which Readings Were Taken		Operator No. and D/T Setting								Points at Which Readings Were Taken		Operator No. and D/T Setting							
		Opr: D/T:		Opr: D/T:		Opr: D/T:		Opr: D/T:				Opr: D/T:		Opr: D/T:		Opr: D/T:		Opr: D/T:	
		Time and Reading (+ or -)										Time and Reading (+ or -)							
Street Traveled	Cross Street or Landmark	T	R	T	R	T	R	T	R	Street Traveled	Cross Street or Landmark	T	R	T	R	T	R	T	R

ODOR INTENSITY RATING SHEET

NAME____________________ DATE____________________

LOCATION____________________ LOCATION____________________

TIME	RATING	COMMENTS	TIME	RATING	COMMENTS

ODOR INTENSITY RATING SUMMARY SHEET

Panelist Location (Station)	Percent Time Detected and Mean Odor Intensity																			
	Date:				Date:				Date:				Date:				Date:			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M

PROCEDURE FOR PROBLEM ASSESSMENT

INTRODUCTION

Tentative methods of problem assessment are contained in the final report, "A Study of the Social and Economic Impact of Odors, Phase II." The principal economic effect of odors can be measured in terms of property value differentials, especially residential property value differentials. A description of the data required and analysis employed in this aspect of problem assessment is presented in Chapter VI. An effects determination questionnaire was developed to determine how residents feel odors have affected themselves, their families, and their properties. Property values, living patterns, and health symptoms are covered. A description of the questionnaire and its use is included in Chapter VII.

WHEN TO ATTEMPT PROBLEM ASSESSMENT

The most common effect of odors — annoyance — is readily measured using the procedure for problem identification. Based on results of the above mentioned study, economic and other social effects are measurable only in an extremely chronic situation. Such a situation may be presumed to exist if more than 50 percent of the test area residents interviewed, using the problem identification questionnaire, state they have been bothered "Very much" by odors in their community (question 10, response 1).

APPENDIX

ESTIMATES OF COSTS INCURRED FROM USING PROCEDURES

Estimates of the costs of services and materials necessary for problem identification and source verification are listed below by task and cost category. Where possible, these estimates are based on 1972 prices averaged for the United States as a whole. Consequently, they may differ somewhat from actual costs incurred in a particular metropolitan area.

Local agency labor requirements are listed in terms of mandays only. Daily rates must be applied by agency officials.

Public Attitude Survey Costs

The estimates given in this section represent the costs of conducting identical public attitude surveys in one test area and one control area.

Task/Category	Estimated Cost	
	Unit	Total
Task I: Select Test and Control Areas		
Supervisory time	1 manday/area	2 mandays
Clerical time	1 manday/area	2 mandays
Purchase of U. S. Census of Population and Housing Census Tract Reports (first survey only)	$5	$5
Purchase of census tract maps for agency's jurisdiction (first survey only; necessary only if maps are not included in U. S. Census of Population and Housing Census Tract Reports	$15	$15
Task II-A: Select Telephone Numbers for Samples		
Clerical time	1 manday/area	2 mandays
Rental of street address telephone directories (for usual six month period)	$50/directory/area	$100

Task/Category	Estimated Cost	
	Unit	Total
Task II-B: Conduct Interviews		
Supervisory time (first survey only)	1 manday	1 manday
Clerical time:		
Training (first survey only)	2 mandays	2 mandays
Interviewing	2 mandays/area	4 mandays
Reproduction of questionnaires	120 questionnaires @ $0.20/questionnaire	$24
Telephone toll charges (if applicable)	60 calls/area @ $0.25/call	$30
Task II (Alternative): Select Sample and Conduct Interviews		
Reproduction of questionnaires	120 questionnaires @ $0.20/questionnaire	$24
Professional survey firm charges:		
Select sample	$50/sample/area	$100
Conduct interviews	60 interviews/area @ $3.50/interview	$420
Telephone toll charges (if applicable)	60 calls/area @ $0.25/call	$30
Task III: Edit Questionnaires		
Clerical time	0.5 manday/area	1 manday
Task IV: Code Questionnaires		
Clerical time	0.5 manday/area	1 manday
Task V: Tabulate Responses		
Clerical time	2 mandays/area	4 mandays
Reproduction of tabulation forms	120 forms @ $0.15/form	$18
Task VI: Evaluate Survey Results		
Supervisory time	1 manday	1 manday
Clerical time	1 manday	1 manday

Task/Category	Estimated Cost Unit	 Total
Estimated Total Costs (Task II Performed By Agency)		
First set of surveys:		
Supervisory time		4 mandays
Clerical time		17 mandays
Services and materials		$192
Each additional set of surveys:		
Supervisory time		3 mandays
Clerical time		15 mandays
Services and materials		$172
Estimated Total Costs (Task II Performed By Professional Survey Firm)		
First set of surveys:		
Supervisory time		3 mandays
Clerical time		9 mandays
Services and materials		$612
Each additional set of surveys:		
Supervisory time		3 mandays
Clerical time		9 mandays
Services and materials		$592

Scentometer Measurement Costs

The following estimates represent the use of a scentometer in routine surveillance for one day.

Task/Category	Estimated Cost Unit	 Total
Task I: Prepare for Field Use		
Purchase of Barnebey-Cheney Model I-3 Scentometer (first use only)	$85	$85
Task II: Conduct Field Measurements		
Technician time:		
Scentometer operator	1 manday	1 manday
Driver	1 manday	1 manday
Agency vehicle use	200 miles @ $0.12/ mile	$24

	Estimated Cost	
Task/Category	Unit	Total
Task III: Evaluate Measurements		
Supervisory time	0.5 manday	0.5 manday
Estimated Total Costs		
First use:		
Supervisory time		0.5 manday
Technician time		2 mandays
Materials		$109
Each additional use:		
Supervisory time		0.5 manday
Technician time		2 mandays
Materials		$24

Odor Judgment Panel Costs

The estimates provided below include the costs of selecting, training, and using twelve odor judgment panelists for source verification in one test area.

	Estimated Cost	
Task/Category	Unit	Total
Task I: Preliminary Activities		
Supervisory time	1 manday	1 manday
Agency vehicle use	100 miles @ $0.12/ mile	$12
Task II: Screen Candidates		
Supervisory time	1 manday	1 manday
Technician time	1 manday	1 manday
Rental of odor free room	$25/day	$25
Purchase of Barnebey-Cheney Model ABB Activated Carbon Room Purifier Unit (first use only)	$480	$480
Purchase of food extracts, mixing bottles, and cups	$10	$10
Payments to candidates (successful candidates only)	12 candidates @ $20/ candidate	$240

Task/Category	Estimated Cost Unit	 Total
Task III: Train Panelists		
Supervisory time	1 manday	1 manday
Technician time	1 manday	1 manday
Rental of odor free room	$25/day	$25
Purchase of odorant, solvents, mixing bottles, plastic bottles	$50	$50
Payments to panelists	12 panelists @ $20/ panelist	$240
Task IV: Perform Field Evaluations		
Supervisory time	1 manday	1 manday
Technician time	1 manday	1 manday
Rental of station wagons	2 station wagons @ $17/day plus $0.17/mile (200 miles)	$68
Reproduction of rating forms	80 forms @ $0.05/ form	$4
Payments to panelists	12 panelists @ $20/ panelist	$240
Task V: Summarize Field Evaluations		
Supervisory time	1 manday	1 manday
Technician time	2 mandays	2 mandays
Estimated Panel Preparation Costs		
First panel:		
Supervisory time		3 mandays
Technician time		2 mandays
Services and materials		$1,082
Each additional panel:		
Supervisory time		3 mandays
Technician time		2 mandays
Services and materials		$602
Estimated (Daily) Field Evaluation Costs		
Supervisory time		2 mandays
Technician time		3 mandays
Services and materials		$312

SUGGESTED REFERENCES

Census Tract Data

U. S. Bureau of the Census. *U. S. Censuses of Population and Housing: 1970. Census Tracts*. Washington, D.C.: U. S. Government Printing Office, 1972.

Census tract data for use by each local agency are recorded in one of a series of reports under the above title. The Bureau of the Census should be contacted to determine the report number for the agency's jurisdiction. Census tract maps are included with these reports.

Odor Judgment Panel Information

Wittes, Janet, and Turk, Amos. "The Selection of Judges for Odor Discrimination Panels," *Correlation of Subjective-Objective Methods in the Study of Odors and Taste*. Special Technical Publication No. 440, American Society for Testing and Materials, 1968.

This comprehensive discussion of the use and analysis of screening tests was co-authored by Amos Turk, the originator of the odor judgment panel technique.

Scentometer Information

Huey, Norman A., Broering, Louis C., Jutze, George A., and Gruber, Charles W. "Objective Odor Pollution Control Investigations," *Journal of the Air Pollution Control Association*, X, No. 6 (December, 1960), 441-446.

This article, by the developers of the scentometer, provides the most comprehensive description available of the physical characteristics of the device and the principles of operation.

Statistical Tables

Mathematical Tables From Handbook of Chemistry and Physics. Cleveland, Ohio: Chemical Rubber Publishing Company, any edition.

Tables of square roots, needed for Odor Problem Identification (see page 33) and other values are included in this mathematical section of the widely used handbook.

The Rand Corporation. *A Million Random Digits With 100,000 Normal Deviates*. Glencoe, Illinois: The Free Press, 1955.

This book contains an extensive listing of 5-digit random numbers. These numbers can be used to select an unbiased sample of test area and control area telephone numbers from a street address telephone directory (see page 10, "Obtaining a Sample"). The first two digits of any of the 5-digit numbers would provide a starting point for areas having zero to 99 listed telephones. Similarly, the first three digits would provide a starting point for areas having zero to 999 listed telephones.